U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-244 816

ECONOMIC ANALYSIS OF EFFLUENT GUIDELINES ORGANIC CHEMICALS INDUSTRY (MAJOR PRODUCTS)

ARTHUR D. LITTLE, INCORPORATED

PREPARED FOR
ENVIRONMENTAL PROTECTION AGENCY

AUGUST 1975

KEEP UP TO DATE

Between the time you ordered this report—which is only one of the hundreds of thousands in the NTIS information collection available to you—and the time you are reading this message, several *new* reports relevant to your interests probably have entered the collection.

Subscribe to the **Weekly Government Abstracts** series that will bring you summaries of new reports *as soon as they are received by NTIS* from the originators of the research. The WGA's are an NTIS weekly newsletter service covering the most recent research findings in 25 areas of industrial, technological, and sociological interest—invaluable information for executives and professionals who must keep up to date.

The executive and professional information service provided by NTIS in the **Weekly Government Abstracts** newsletters will give you thorough and comprehensive coverage of government-conducted or sponsored research activities. And you'll get this important information within two weeks of the time it's released by originating agencies.

WGA newsletters are computer produced and electronically photocomposed to slash the time gap between the release of a report and its availability. You can learn about technical innovations immediately—and use them in the most meaningful and productive ways possible for your organization. Please request NTIS-PR-205/PCW for more information.

The weekly newsletter series will keep you current. But *learn what you have missed in the past* by ordering a computer **NTISearch** of all the research reports in your area of interest, dating as far back as 1964, if you wish. Please request NTIS-PR-186/PCN for more information.

WRITE: Managing Editor
5285 Port Royal Road
Springfield, VA 22161

Keep Up To Date With SRIM

SRIM (Selected Research in Microfiche) provides you with regular, automatic distribution of the complete texts of NTIS research reports *only* in the subject areas you select. SRIM covers almost all Government research reports by subject area and/or the originating Federal or local government agency. You may subscribe by any category or subcategory of our WGA **(Weekly Government Abstracts)** or **Government Reports Announcements and Index** categories, or to the reports issued by a particular agency such as the Department of Defense, Federal Energy Administration, or Environmental Protection Agency. Other options that will give you greater selectivity are available on request.

The cost of SRIM service is only 45¢ domestic (60¢ foreign) for each complete microfiched report. Your SRIM service begins as soon as your order is received and processed and you will receive biweekly shipments thereafter. If you wish, your service will be backdated to furnish you microfiche of reports issued earlier.

Because of contractual arrangements with several Special Technology Groups, not all NTIS reports are distributed in the SRIM program. You will receive a notice in your microfiche shipments identifying the exceptionally priced reports not available through SRIM.

A deposit account with NTIS is required before this service can be initiated. If you have specific questions concerning this service, please call (703) 451-1558, or write NTIS, attention SRIM Product Manager.

This information product distributed by

NTIS U.S. DEPARTMENT OF COMMERCE
National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22161

TECHNICAL REPORT DATA PAGE	1. Report No. EPA-230/2-75-019	2.	3. Recipient's accession No. PB244816
4. Title and Subtitle Economic Analysis of Effluent Guidelines – Organic Chemicals Industry			5. Report Date August 1975 6.
7. Author(s)			8. Performing Organization Rept. No. C-75938-05
9. Performing Organization Name and Address Arthur D. Little, Inc. Acorn Park Cambridge, Massachusetts 02140			10. Project/Task/Work Unit No. Task Order No. 38 11. Contract/Grant No. 68-01-1541
12. Sponsoring Organization Name and Address Office of Planning and Evaluation Environmental Protection Agency Washington, D.C. 20460			13. Type of Report & Period Covered Final 14.

15. Supplementary Notes

The Development Document for this report is available through GPO. Order No. EP1.8/3:OR3

16. Abstracts

An initial analysis of the economic impact of proposed water effluent guidelines upon the organic chemicals industry (SIC 2815/2865 and 2818/2869) was performed based on abatement cost data supplied by the EPA. In view of limited cost data available, the impact was based on best practicable control technology currently available. On this basis with 75% coverage of the industry, the following specific chemicals appear to face significant water pollution control problems: ethylene glycol, caprolactam, methanol, acetic acid, acetone, phenol, aniline, coal tar products, ethyl cellulose, dyes & pigments, and unformulated pesticides. Extrapolating to the entire industry, minimum total annual cost by 1977 would be an estimated $194 million with the maximum cost $590 million. On the basis of maximum cost, a very severe fixed capital requirement of $576 million per annum over the period 1973-1977 would be imposed on the industry. This is about 72% of the 1972 capital investment by the industry. On the minimum impact basis, prices would rise by 1.6% over the five-year period and profits after taxes in years of full compliance depressed by 8% below that of the 1972 base year. On the basis of maximum impact, prices would rise by about 3.7% over the five years, and annual profits would be depressed by 37% of the 1972 base year.

17. Key Words and Document Analysis. 17a. Descriptors

Economic Analysis
Effluent Guidelines
Organic Chemicals
Organic Chemicals Industry

17b. Identifiers/Open-Ended Terms

17c COSATI Field/Group

Reproduced by
NATIONAL TECHNICAL INFORMATION SERVICE
U.S. Department of Commerce
Springfield, VA. 22151

PRICES SUBJECT TO CHANGE

18. Availability Statement	19. Security Class (This Report)	21. No. of Pages
This document will be available through the National Technical Information Service, Springfield, Virginia 22151	UNCLASSIFIED	114
	20. Security Class (This Page) UNCLASSIFIED	22. Price 5.25 - 2.25

PREFACE

The attached document is a contractor's study prepared with the supervision and review of the Office of Planning and Evaluation of the U.S. Environmental Protection Agency (EPA). Its purpose is to provide a basis for evaluating the potential economic impact of effluent limitations guidelines and standards of performance established by EPA pursuant to sections 304(b) and 306 of the Federal Water Pollution Control Act.

The study supplements an EPA technical "Development Document" issued in conjunction with the promulgation of guidelines and standards for point sources within this industry category. The Development Document surveys existing and potential waste treatment and control methods and technologies within this category and presents the investment and operating costs associated with various control technologies. This study supplements that analysis by estimating the broader economic effects (including product price increases, continued viability of affected plants, employment, industry growth and foreign trade) of the required application of certain of these control technologies.

This study has been submitted in fulfillment of Contract No. 68-01-1541, Task No. 38 by Arthur D. Little, Inc. Work was completed as of August 1, 1975. The study is based primarily upon an earlier study, also prepared by Arthur D. Little, Inc., entitled "Economic Analysis of Proposed Effluent Guidelines — Organic Chemicals Industry." The earlier report was circulated in conjunction with the publication of the Federal Register of a notice of proposed rulemaking under sections 304(b) and 306 for the subject point source category. Because of the constraints of time, the control and treatment costs analyzed in this study may not in all instances be identical to those associated with the requirements of the promulgated regulation. However, those differences, when they exist are minor insofar as the final conclusions of the study are concerned.

This report represents the conclusions of the contractor. It has been reviewed by the Office of Planning and Evaluation and approved for publication. Approval does not signify that the contents necessarily reflect the views of the Environmental Protection Agency. The study has been considered, together with the Development Document, information received in the form of public comments on the proposed regulation, and other materials in the establishment of final effluent limitations guidelines and standards of performance.

Preceding page blank

TABLE OF CONTENTS

	Page
List of Tables and Figures	vii
INTRODUCTION AND SUMMARY	1
THE ORGANIC CHEMICAL INDUSTRY	5
Its Size	5
Companies and Plants	5
Basic Organics	5
Large Volume Intermediates	5
Small-Volume Intermediates and Finished Products	6
Geographic Location	6
Industry Growth and Profits	6
THE IMPACT OF WATER POLLUTION CONTROL ON THE ORGANIC CHEMICAL INDUSTRY	9
The Cost of Water Pollution Abatement	9
THE ECONOMIC IMPLICATIONS OF WATER POLLUTION ABATEMENT	19
APPENDIX A – THE ORGANIC CHEMICAL INDUSTRY	A-1
APPENDIX B – REGIONAL PLANT LOCATIONS FOR MAJOR ORGANIC CHEMICALS	B-1

Preceding page blank

LIST OF TABLES AND FIGURES

Table No.		Page
1	Potential Water Pollution Problems Due to the Process Water Use in the Organic Chemicals Industry	10
2	Specific Water Pollution Control Costs, Best Practicable Control Technology Currently Available – 95% Removal	13
3	Cost of Water Pollution Control Costs as Percent of Sales Prices for Specific Organic Chemicals – Best Practicable Control Technology Currently Available	21
4	Profitability and Impact on Specific Organic Chemicals Best Practicable Water Pollution Control Technology Currently Available (95% Removal)	23
5	Companies in the Basic Chemical Industry According to Assets	31

Figure No.		Page
1	Aqueous Pollution Abatement Costs – Category B (Process Water Contacts as Steam Diluent and/or Absorbent) Best Practicable Control Technology – 95% Removal	15
2	Aqueous Pollution Abatement Costs – Category C (Aqueous Liquid-Phase Reaction Systems) Best Practicable Control Technology – 95% Removal	16

Preceding page blank

INTRODUCTION AND SUMMARY

This final report is submitted on a best efforts basis in compliance with Contract No. 68-01-1541 with the Environmental Protection Agency on the "Economic Impact of Water Pollution Control on the Organic Chemicals Industry." It must be emphasized that the estimates in this initial study must be considered as order-of-magnitude figures.

Using the Effluent Limitations Guidelines supplied to us by the EPA, we evaluated the 70 products or product classes developed during Phase I, which cover about 75% of the sales and volume of the organic chemical industry. Thirty-six of these products or product classes present potential water pollution problems. Of these, we could make a quantitative economic impact evaluation for only 17 products; lack of data prevented a similar study of the other products on the list. On the basis of data supplied by the EPA, which was compiled by Roy F. Weston, Inc.,[1] we first determined the cost of suggested best practicable control technology currently available (using the 95% treatment efficiency at the suggestion of the EPA) and compared that to the average selling price in 1972, the base year selected because it represents a more average year with regard to profits than most other recent years.

Costs of water pollution control, as a percent of sales value, ranged from a low of 0.4% to a high of 8.31%, for a weighted average value of about 4%, using best practicable technology at the most rigorous suggested guideline level of 95% removal. The cost differences among the several levels of removal efficiency are reported to be marginal. Using a profitability index developed during this project, and combining it with an abatement cost index, we arrived at an economic impact index for those products for which specific abatement cost data was available. Of the 17 examined, 7 face a difficult problem because of either high abatement costs, a poor market picture, or a combination of both. These products, in roughly declining degree of concern, are: ethylene glycol, caprolactam, methanol, acetic acid, acetone, phenol, and aniline.

It must be emphasized that in our belief other products or product classes face significant problems, even though we do not have the cost data to back up our belief. In our judgment these include (but may not be limited to) coal tar products, ethyl cellulose, dyes and organic pigments, and possibly some unformulated pesticides.

Insufficient data was supplied to us by the EPA to make a judgment of the economic impact of suggested best available technology economically achievable standards, new source effluent standards, or new source pretreatment standards. Costs for the first two standards were prepared only for a single size facility, and no cost data was developed for the new source pretreatment standards. All comments about the economic impact on the organic chemical industry are limited to the best practicable control technology currently available standards.

1. "Draft Development Document for Effluent Limitations Guidelines and Standards of Performance, Organic Chemical Industry," Prepared by Roy F. Weston, Inc., for the United States Environmental Protection Agency under Contract Number 68-01-1509, dated June 1973.

We have made a minimum and maximum estimate of the economic impact on the organic chemical industry. The minimum is based on the estimate that half of all organic chemicals had such minor pollution problems that the cost of meeting the suggested effluent guidelines would not exceed 1% of sales price. This estimate of half of all organics is based on categories given in the EPA Development Document and on those developed by this contractor of the raw effluent load of 70 products or product classes that represent about 75% of the industry's volume and sales. The other half would have an average cost of about 4% of sales. On the basis that the organic chemical industry's sales in 1972 equaled $8 billion, we estimate the total cost in complying with the guideline would reach $194 million annually. This cost would depress the organic chemical industry's after-tax profits by 8% of the 1972 base if two-thirds of the cost could be passed on to customers. Some of the costs probably could not be passed on to consumers, since the more efficient producers, we believe, would try to enhance their competitive position by not meeting all price increases of the producers that have higher manufacturing or higher pollution control costs. Prices would rise by 1.6% over the five years but growth in demand would not be influenced significantly.

On the basis of capital costs needed to meet the suggested guidelines using the best practicable control technology currently available, we arrived at a maximum cost estimate. This estimate indicates that the industry would have to make a capital investment of $2.88 billion over the five-year period 1973-1977 to meet suggested standards. During this period, the average annual capital investment required would be $576 million, which is 72% of the industry's total new capital expenditures of $804 million in 1972.

Amortization charges (depreciation and capital costs) at an annual rate of 10.2% represented about half of total annual costs, so the industry's total cost is projected at $590 million annually when in full compliance. We believe that only half of this total could be passed on to customers, in part because of competitive pressure within the industry, but more because of the large price increases expected as a result of the rapidly rising costs of energy and feedstocks and the competition with products made by other industries. Consequently, the industry's net after-tax profit would be depressed by 37% of the 1972 base; prices would rise by 3.7% over the five years but this price increase would not significantly affect growth in demand. However, lack of sufficient capital to invest in increased production coupled with the closing of a significant number of small plants could be a serious hindrance to meeting the growth in demand.

These two figures are the maximum and minimum limits of the economic impact on the industry. The truth lies between them and in our belief closer to the minimum than the maximum.

In any event, plants will be closed and the industry further concentrated in larger companies, since the most vulnerable companies will be those that are small, are marginally profitable and have plants in isolated locations. While quite a few such plants are expected to close, the unemployment should not be great, since it is those plants employing 20 or less that are must vulnerable.

The limitations of this study are obvious. Extrapolations to an industry level, based on a relatively small sample, can be very unreliable. The EPA must develop more detailed control cost data for the four levels of effluent standards before the range in estimates of economic impact can be narrowed to a reliable level. Particular attention is called to the practical necessity to limit this study to 70 products or product classes. Although these cover about 75% of the industry's sales, there is no reliable way to extrapolate the results to the 25% of the industry not covered. Because the fraction omitted is not large, the overall dislocation is not expected to be major. However, there are likely to be hardship cases in the unstudied sector of the industry and such companies will require special consideration. In any further study, therefore, not only must more detailed data be prepared on the 70 products or product classes, but also on the other quarter of the industry, which represents a very large number of small-volume products.

THE ORGANIC CHEMICAL INDUSTRY

Its Size

The organic chemical industry produces 80 to 90 million tons of chemicals each year. Thousands of compounds are made, ranging in production volume from a high of about 10 million tons of ethylene to very small quantities of reagent chemicals. However, 70 chemicals or classes of chemicals account for about three-fourths of the industry's sales, which in 1972 totaled an estimated $8 billion. Appendix A gives a more detailed statistical description of the organic chemical industry.

Companies and Plants

Nearly 500 companies are engaged in producing organic chemicals; however, the four largest producers account for a minimum of 36% and the first hundred for more than 92% of total shipments. Not only are there very large companies producing large volumes of chemicals, but also major companies in other industries such as petroleum, have significant chemical production. At the other end of the spectrum are many small companies operating small plants. There are about 27 plants employing more than one thousand, and about 220 plants with less than 10 employees. The large plants produce a wide variety of different chemicals and their effluent will generally be treated in a centralized water treatment plant. On the other hand, many of the smaller plants dump their effluent into public utility sewer systems.

Basic Organics

The products are primarily basic organic chemicals, which are generally petroleum based and to a much, and increasingly, lesser degree, coal based. These basic organics are generally produced in large-volume continuous process plants whose location is heavily oriented to their raw material (feedstock) source — natural gas fields, petroleum refineries or coke oven operations.

Large-Volume Intermediates

Because the basic chemicals are the raw material for upgraded intermediates, these intermediates are frequently made in the same plant to save freight cost, or by purchasers at adjacent plant sites that receive the basic organics by pipeline. Hence, the major portion of large-volume intermediates is also likely to be produced where their raw materials are found. Most large-volume intermediates are also produced via continuous processes and their unit value is likely to be at least double that of the basic organics.

Preceding page blank

Small-Volume Intermediates and Finished Products

While many of the large-volume intermediates are used directly in the production of finished chemicals – generally in the form of polymers such as resins, plastics, and synthetic fibers – a significant quantity goes into the production of the smaller-volume intermediates and finished products such as plasticizers, dyes and organic pigments, and pesticides. Typically, these products are likely to be located nearer the markets than the raw materials and their unit value may average more than 20 times that of the basic organics, although their physical volume is less than one-tenth that of the basics. Producers of small-volume intermediates and end products in many cases are producers of basic organics. Increasingly, with upgrading, the raw material costs become a less important part of total cost of the chemicals and other, nonintegrated, companies become more important. Continuous processes are used, but batch processes are likely to be more common and with this labor costs become a larger share of total cost.

Geographic Location

This general pattern of raw material or market orientation is evident in the geographic distribution of the organic chemical industry. About 35% of the industry, based on number of employees, is located in the Northeast, with much of it located in New Jersey, which accounts for about one-quarter of the industry's total employment. The South is responsible for nearly 45% of employment (and much larger percentage of tonnage) with Texas and Louisiana responsible for much of that. The Midwest accounts for less than 20% and the West has less than 5% of the organic chemical industry's employees. The Gulf Coast, principally Texas and Louisiana, is predominantly the source of basic organics – large-volume, low-cost and -priced, continuous processing – while the Northeast accounts for a major share of the upgraded products such as dyestuffs, flavor and fragrances, and other high-value, low-volume products.

Appendix B shows the location of those organic chemicals plants that make the compounds for which specific water pollution control costs were prepared. The plant locations oriented to raw material are clearly indicated for basic and large-volume intermediate organic chemicals, as is the market orientation of most small-volume intermediates and finished products.

Industry Growth and Profits

Dollar sales of the organic chemical industry have grown at an annual rate of about 7-1/2% over the last 15 years, but in actual volume of production growth has been closer to 8-1/2% per year because the unit prices of organic chemicals, on average, have actually declined in current dollars by nearly 15% over that 15-year period, 1958-1972. (Many categories of organics have declined by much more.) Although productivity improvements have helped maintain the unit labor costs in the industry, increases in raw materials, energy, and plant construction and erection costs have not permitted costs to be reduced by a

corresponding 15%. The difference has come out of profits and the industry's profitability has definitely been squeezed over the 15 years, with periodic upturns in profits generally the result of better utilization of production capacity, as is the case in 1972.

Competition between chemical companies' and petroleum companies' chemical operations (of which many of the latter overexpanded in the sixties and had poor marketing programs), competition with foreign imports in some cases, and finally, competition with nonchemical substitutes, contributed to the general decline in prices and the industry's profits.

THE IMPACT OF WATER POLLUTION CONTROL ON THE ORGANIC CHEMICAL INDUSTRY

In an industry as diverse and complex as the organic chemical industry one cannot generalize beyond saying that all members of the industry will be affected. The degree of the economic impact will vary considerably among companies, plants, and products. In an effort to differentiate among products and product classes, we have developed a grouping of products and product classes that account for about 75% of the organic chemical industry's total sales. Table 1 lists this grouping and the process water use categorization.

The Cost of Water Pollution Abatement

Data submitted in the EPA Draft Development Document have been used to calculate the cost of meeting the proposed guidelines for specific chemicals that may have serious impact potential. Of the 70 products or product classes reviewed, about half exhibit a potentially severe impact because of their raw effluent load. In Table 2 we have compiled a list which includes all of the chemicals in categories C&D of the EPA Development Document plus five we believe may present a potential problem even though they are not in categories C&D. Of this list of 36 products, the Document includes survey data for 22.

We have been able to apply the Development Document results to the calculation of the cost of pollution abatement for 17 products. Of the other five surveyed, three yield results not considered reliable because of the degree of extrapolation required (tetraethyl lead, bisphenol, and phthalate plasticizers), one on which we take exception to Document data (coal tar in which problems related to tar acid and tar base refining were not considered), and one where the data is not specific enough to make the calculations (dyes and pigments).

Cost Based on Best Practicable Control Technology Currently Available. For this analysis we have used, as reported, estimates given in the EPA Development Document of treatment plant investment and operating costs, and of effluent hydraulic load. With regard to cost for best practicable control, the data appear to be reasonable. In the second instance we have no way to judge the reasonableness of the hydraulic load but note that it is stated to be the result of a field survey.

Estimates of the pollution abatement costs are included in the EPA Development Document for each product category, as a function of the waste treatment plant hydraulic load. At the instruction of EPA, we used the data for categories B-1 and C-1. These estimates were based on 95% treatment efficiency, and costs are marginally higher than for less efficient waste treatment. For our cost calculation we used an "amortization" charge equal to capital recovery in 20 years with interest at 8%. This charge is equivalent to 10.2% of investment per year. After this adjustment was made to Tables VIII-2 and VIII-5 in EPA Draft Development Document, we plotted waste treatment flow (gpd) versus annual cost (Figures 1 and 2).

Preceding page blank

TABLE 1

POTENTIAL WATER POLLUTION PROBLEMS DUE TO THE PROCESS WATER USE IN THE ORGANIC CHEMICALS INDUSTRY

	Develop Document Category[1]
A. Basic Organic Chemicals	
1. Coal Derived Basics	
2) Coal tar acids	C
2) Coal tar crudes	C
2) Coal tar distillates	C
2) Naphtha solvents	C
2) Naphthalene	C
2) Anthracene	C
2) Creosote	C
2) Cresols	C
2) Cresylic	C
2) Acid	C
2) Pitch	C
2) Tar	C
2) Benzene	A
2) Toluene	A
2) Xylene	A
2. Petroleum Derived Basics	
Acyclic	
2) Ethylene	B
2) Propylene	B
2) Acetylene	B
2) Butadiene	B
Cyclic	
2) Benzene	A
2) Toluene	A
2) Xylene	A
B. Large-Volume Intermediates and Finished Organics Including:	
3. Resin Intermediates	
2) Ethyl benzene & styrene	A & B
2) Vinyl chloride	A & B
2) Ethyl acrylates & methylmethacrylates	C
2) Vinyl acetate	C

TABLE 1 (Continued)

	Develop Document Category
4. Fiber Intermediates	
2) Cyclohexane	A
Acrylonitrile	C
Adipic acid	C
Hexamethylene diamine & tetramine	B
2) Caprolactam	C
2) Dimethyl terephthalate	C
5. Chlorinated Hydrocarbons	
Methyl chloride	B
Methylene chloride	B
Chloroform	B
Carbon tetrachloride	B
Ethyl chloride	B
2) Ethylene dichloride	B
Trichloroethylene	B
Perchloroethylene	B
Methyl chloroform	B
Fluorinated hydrocarbons	B
6. Miscellaneous, Generally Derived From:	
C_1	
2) Methanol	B
2) Formaldehyde	B
Pentaerythritol	C
Phosgene	A
C_2	
2) Acetaldehyde	B & C
2) Acetic acid	C
Acetic anhydride	B
Ethanol	C
Ethyl cellulose	C
2) Ethylene oxide and glycol	B & C
2) Tetraethyl lead	C
C_3	
Glycerin	B
Isopropanol	B & C
Isocyanates	C
Propylene oxide	C
Propylene glycol	C
2) Acetone	C

TABLE 1 (Continued)

		Develop Document Category
	C_4	
	Methyl ethyl ketone	C
2)	Oxo chemicals (including long-chain alcohols)	C
	Aromatics	
	Cumene	A
2)	Phenol/Acetone	C
2)	Aniline	C
2)	Bisphenol	C
	Phthalic anhydride	B
2)	Para-cresol	C
C.	Small-Volume Intermediates and End Product Organics	
2) 7.	Dyes & organic pigments	D
8.	Rubber processing chemicals	D
9.	Flavors and fragrances	D
10.	Unformulated pesticides	D
2) 11.	Plasticizers	B & D
D.	Miscellaneous Intermediates	Not categorized

1) Development Document Category
   - A - Non-aqueous processes
   - B - Process water as steam diluent and/or absorbent
   - C - Aqueous liquid-phase reaction systems
   - D - Batch and semi-continuous processes

2) Draft document investigated effluent control costs for this product or product class

TABLE 2

SPECIFIC WATER POLLUTION CONTROL COSTS, BEST PRACTICABLE CONTROL TECHNOLOGY CURRENTLY AVAILABLE – 95% REMOVAL

Product	Develop Document Category [3]	Typical Plant Size [3] (million lb/yr)	Hydraulic Load [3] (gal/1000 lb)	Hydraulic Load [3] (gpd)	Abatement Cost [4] ($/yr)	Abatement Cost [4] (¢/lb)
Basic Organic Chemicals						
* Coal Tar	C	--	405 [1]		2)	2)
Large Volume Intermediates						
Resin Intermediates						
* Vinyl Chloride	A & B	400	336	379,000	310,000	0.08
* Ethyl Acrylate	C	250	3,000	2,113,000	2,950,000	1.18
* Methyl Methacrylate	C	80	260	59,000	450,000	0.56
* Vinyl Acetate	C	300	28	24,000	300,000	0.10
Fiber Intermediates						
Acrylonitrile	C				2)	2)
Adipic Acid	C				2)	2)
* Caprolactam	C	150	1,334	564,000	1,450,000	0.97
* Dimethyl Terephthalate	C	250	450	317,000	1,050,000	0.42
Chlorinated Hydrocarbons						
* Ethylene Dichloride	B	500	96	135,000	160,000	0.032
Miscellaneous Derived from C_1						
* Methanol	B	659	50	93,000	130,000	0.02
Pentaerythritol	C				2)	2)
Miscellaneous Derived from C_2						
* Acetaldehyde	B & C	300	61	52,000	440,000	0.15
* Acetic Acid	C	300	500	423,000	1,230,000	0.41
Acetic Anhydride	B				2)	2)
* Ethylene Oxide	B	200	20	11,000	50,000	0.03
* Ethylene Glycol	C	250	584	411,000	1,200,000	0.48
* Tetraethyl Lead	C	300	12,000	10,141,000	(6,900,000) [5]	(2.30) [5]
Ethanol	C				2)	2)
Ethyl Cellulose	C				2)	2)
Miscellaneous Derived from C_3						
Isopropanol	B & C				2)	2)
Isocyanates	C				2)	2)
Propylene Oxide	C				2)	2)
Propylene Glycol	C				2)	2)
* Acetone	C	120	230	78,000	120,000	0.10
Miscellaneous Derived from C_4						
Methyl Ethyl Ketone	C	2)	2)	2)	2)	2)
Miscellaneous Derived from Aromatics						
* Oxochemicals	C	200	420	237,000	860,000	0.43
* Phenol/Acetone	C	400	200	225,000	850,000	0.21
* Aniline	C	70	190	37,000	350,000	0.50
* Bisphenol A	C	50	67	9,400	(327,000) [5]	(0.65) [5]
* Para-cresol	C	10	1,291	36,000	350,000	3.50
Small Volume Intermediates & End Product Organics						
* Dyes & Organic Pigments	D	--	13,700/124,000		2)	2)
Rubber Processing Chemicals	D				2)	2)
Flavors & Fragrances	D				2)	2)
Unformulated Pesticides	D				2)	2)
* Plasticizers	B & D	75	78.3	16,500	2)	2)

1) Gal/1000 gal - does not include waste water from tar acid or tar base operations.
2) Insufficient data available to determine cost.
3) Based on data supplied by EPA, "Draft - Development Document for Effluent Limitations Guidelines and Standards of Performance - Organic Chemicals Industry", Roy F. Weston, Inc., June 1973.
4) Derived by Contractor from source cited in footnote 3).
5) This data is suspect; a more detailed survey is required.

* - Draft document investigated effluent control costs for this product or product class.

For each of the products we next selected a typical plant size. This selection was based on our knowledge of the industry and was assisted by tabulation of plants given in the EPA Development Document for each product. Effluent flow to the treatment plant was then calculated by multiplying the plant size by the tabulated flow factor (gal effluent/1000 lb product). Annual cost was then read from Figure 1 or Figure 2 and unit cost (¢/lb product) calculated. These results are also summarized in Table 2.

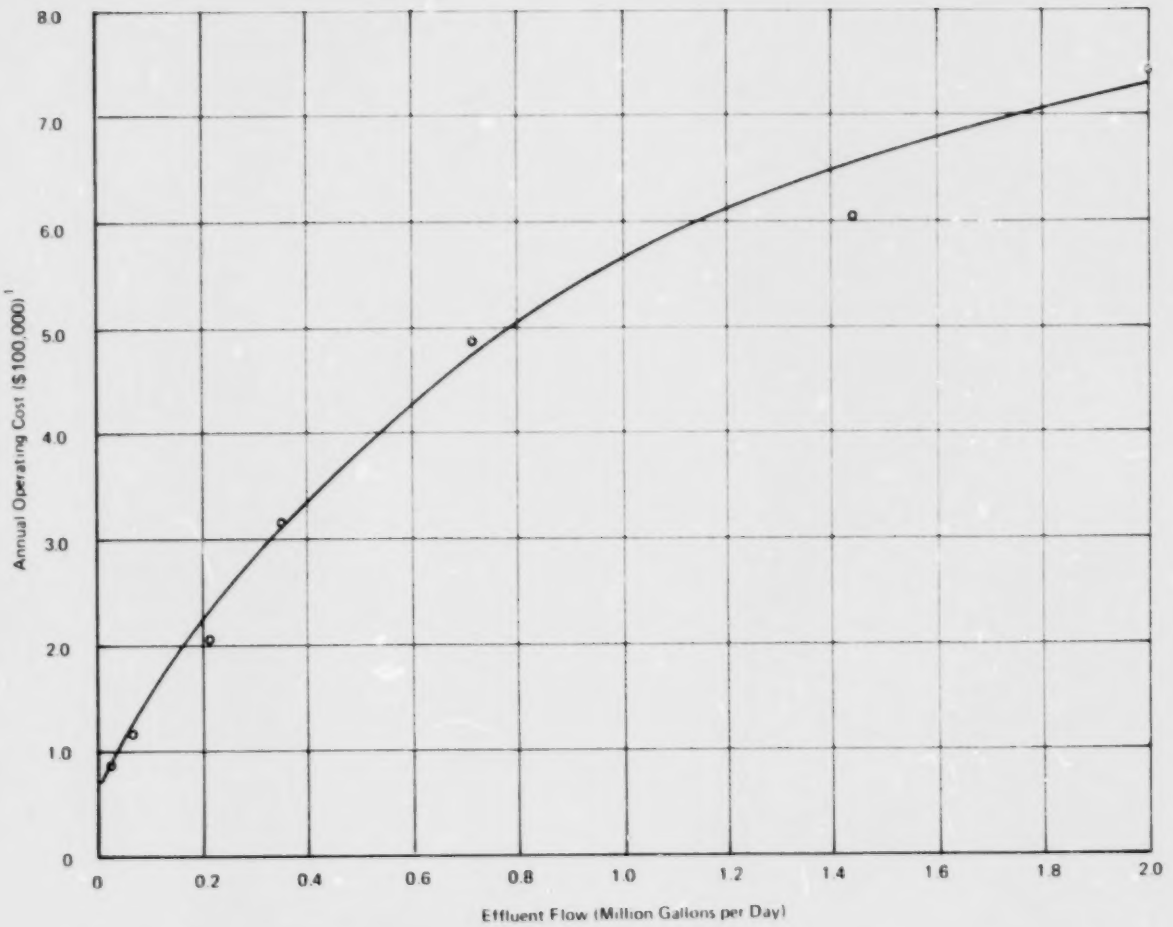
It is recognized that many of these products are manufactured at a common plant site with others, and therefore share a consolidated treatment plant. The EPA Development Document suggests this problem be analyzed for specific plant sites by a "building block" approach which sums up the contribution of each product. In a plant where all products had similar waste problems the result, as a back charge cost to each product, would be about the same as our calculation, and for the generalizations necessary at this time is the best estimate possible.

Costs of Advanced Levels of Control. Our discussion of the cost of pollution abatement has been addressed to best practicable control technology currently available. We were also commissioned to consider: (1) best available technology economically achievable, (2) new source effluent standards, and (3) new source pretreatment standards. However, data to make an adequate study are sorely lacking. The cited Draft Document recommends a single guideline for (1) and (2) above, and presents cost data (in its Table VIII-11) for only a single size of facility (720,000 gpd of effluent) with treatment based solely on activated carbon adsorption of impurities.

The best available technology investment for Category C is stated to be $1,178,000, and annual costs adjusted to our basis would be:

Operating & Maintenance	$124,200
Energy & Power	14,000
10.2% Investment	120,200
	$258,400

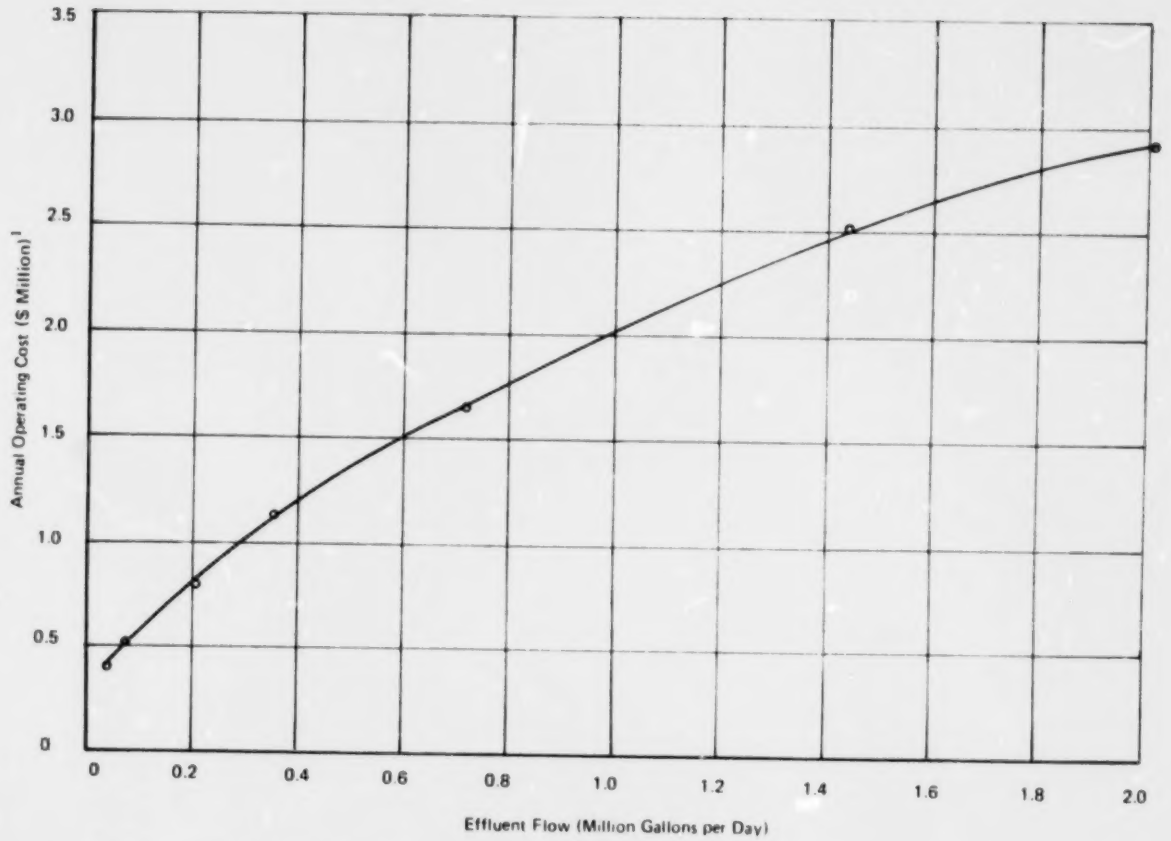
Only three products listed in Table 2 have effluent loads of 400,000 to 900,000 gpd; and any unit not in that range is not considered appropriate for application of this cost. These products and the result of adding treatment, on the basis of the data given in the EPA Development Document, are:



Source: Adapted from Table VIII-2 "Draft Development Document for Effluent Limitations Guidelines and Standards of Performance -- Organic Chemical Industry", Roy F. Weston Inc., June 1973.

1) Includes annual capital charges

FIGURE 1 AQUEOUS POLLUTION ABATEMENT COSTS – CATEGORY B (PROCESS WATER CONTACTS AS STEAM DILUENT AND/OR ABSORBENT) Best Practicable Control Technology – 95% Removal



Source: Adapted from Table VIII-5 "Draft Development Document for Effluent Limitations Guideline and Standards of Performance – Organic Chemical Industry", Roy F. Weston Inc., June 1973.

1) includes annual capital charges

FIGURE 2 AQUEOUS POLLUTION ABATEMENT COSTS – CATEGORY C (AQUEOUS LIQUID – PHASE REACTION SYSTEMS) Best Practicable Control Technology – 95% Removal

Product	Effluent gpd	Plant Size (million lbs/yr)	Best Economically Achievable Control Cost ($/yr)	Best Economically Achievable Control Cost (¢/lb)	Best Practicable Control Cost (¢/lb)	Total Cost (¢/lb)
Caprolactam	564,000	150	258,400	0.17	0.97	1.14
Acetic Acid	423,000	300	258,400	0.09	0.41	0.50
Ethylene Glycol	411,000	250	258,400	0.10	0.48	0.58

This calculation indicates best economically achievable abatement would add only about 20% to the cost of best practicable control; it is a highly suspect result when one considers the uncertainty of guidelines which may, in fact, be proposed and when the specific problems for meeting those guidelines at specific locations are considered. We have included this calculation only to illustrate our point of view, and we do not recommend an attempt to extend it to other products.

The cost consideration of pretreatment for new plants using municipal facilities were not included in the study reported in the EPA Development Document. Its application would be to the segment of the industry typified by the large number of small plants in urban areas such as New Jersey. We have pointed out elsewhere in this report the special problems such plants pose; they will present severe economic impact problems and they require plant-by-plant analysis not possible in this assignment.

THE ECONOMIC IMPLICATIONS OF WATER POLLUTION ABATEMENT

The ability of a company to absorb or pass on the cost of water pollution control for its products depends on the products' average profitability and/or price elasticity in the marketplace. If the product or product class is producing a profit margin better than the industry in general, the producer may be able to absorb the increased cost due to water pollution control and if, in addition, he can pass on all or at least some of the cost to his customers in selling price, his profits will be depressed only slightly or not at all. At the other extreme is a company that currently suffers a poor profit margin and that will lose its market to other more efficient producers, imports or other competitive substitute products if it raises prices. In this case the company or the product is already marginal, and the cost of water pollution control, or a combination of water, air and solid waste pollution costs plus OSHA will act as severe pressures to close his plant or discontinue the particular product or product line, especially if he can see no opportunity to realize at least a positive cash flow. In many instances, because the product has not been very profitable, the plants are old and have not justified major reinvestment and the resulting depreciation will not generate sufficient cash flow to offset direct operating costs or warrant continued operation.

Production Costs. Production costs are very sensitive to capacity utilization, since organic chemicals are fairly high in their capital intensiveness, that is, the amount of fixed capital investment needed to generate a specific amount of sales, to say nothing of profits. For example, in 1967, the last year for which reasonably accurate statistics are available, organic chemical commercial shipments (nearly the same as sales) of about $5.6 billion required a depreciable fixed investment of $8.5 billion; that is, each dollar of fixed investment generated about $0.65 in sales. That fixed investment will obviously produce more profit if it is operating at 96% than at 78%, each an average figure experienced in one of the last five years.

Although fixed cost, particularly depreciation, is high, other fixed costs – such as technical service, distribution and sales costs – also contribute to total cost. Depreciation accounts on average for 10-15% of cost.

Variable costs for raw materials, labor and utilities loom very large in production costs, averaging for the industry 75-80% of total costs. In recent years raw materials and utility costs particularly have risen more rapidly than the price received for chemicals. Based on a price of 100 for 1967, the average price for all industrial commodities rose to an average of 117.9 in 1972, and utilities and fuels to 118.6. Organic chemicals were at 96.2 or less on average in that year.

Unit labor costs had been kept relatively stable, thanks primarily to increased productivity, which in turn is due largely to increased capital investment. It is likely that increased production costs due to pollution control cannot be absorbed by increased productivity, especially in view of the increases in cost being experienced by the chemical industry for its hydrocarbon feedstocks and energy. As a generalization, we believe production costs will

Preceding page blank

increase with or without the additional burden of air, water, or solid waste pollution costs, to say nothing of operating expenses required through OSHA.

Price Elasticity. If, as we believe, operating costs will not be reduced, nor for that matter maintained at their present level (especially as plants are already operating close to their capacities), it would appear that the only way organic chemical companies can recover the cost of water pollution control, if they are to recover it at all, is through increased selling prices in the marketplace.

Companies' ability to increase prices depends on whether the Government permits price increases, whether more efficient or less realistic competitive organic chemical producers will also raise prices, or whether customers will feel justified in paying more for a particular chemical in preference to a competitive alternative chemical or a nonchemical product. In general terms, organic chemicals have grown at a rate of 8-1/2% in physical volume in part because their cost to customers has risen far less (in fact, dropped) in comparison to many competitive nonchemical materials. Hence, in general terms, it is reasonable to assume that even with an increase in selling price, and the resulting decline in the annual rate of growth, there will still be steady growth by the organic chemical industry. However, generalities do not take into account specific organic chemicals.

The Economic Impact of Water Pollution Control on Specific Organic Chemicals. We are assuming that those products in Development Document Category A – that is, those where water is not a process material, and aqueous waste is discharged only as utility unit blow-down or as an incidental wash stream – do not face a water pollution control problem of sufficient magnitude to justify further review in this study. Similarly, those products in Category B – where water is an inherent process material used as a steam diluent and/or absorbent but is discharged only as a purge stream in quantities small in comparison to the production rate – need no further attention in this study in view of Development Document estimates of the cost of control using the best practicable control technology currently available. (See Figure 1.)

However, Categories C&D – Aqueous Liquid-Phase Reaction Systems and Batch and Semi-Continuous Processes, respectively – require further review. One measure of the impact of pollution control is to compare the cost of treatment as a percent of selling price for those products which have developed sufficient data to permit us to estimate abatement cost per pound of product produced. The results are shown in Table 3. These products had sales of about $1,050 million in 1971 and the weighted average abatement cost, as a percent of sales price, was 3.86.

We have also evaluated the profit margin to absorb the increased cost and/or ability to pass on all or some of the increased cost to consumers for all products in Categories C&D. In general, a product that normally has a profit margin lower than the average of the organic

TABLE 3

COST OF WATER POLLUTION CONTROL COSTS AS PERCENT OF SALES PRICES FOR SPECIFIC ORGANIC CHEMICALS – BEST PRACTICABLE CONTROL TECHNOLOGY CURRENTLY AVAILABLE

Product	Development Document Category	Abatement Cost [1] (¢/lb)	1972 Sales Price [2] (¢/lb)	Abatement Cost As Percent of Sales Price (%)
Large-Volume Intermediates				
Vinyl chloride	A & B	0.08	4.17	1.92
Ethyl acrylate	C	1.18	17.90	6.59
Methyl methacrylate	C	0.56	18.50*	3.03
Vinyl acetate	C	0.10	7.79	1.28
Fiber Intermediates				
Caprolactam	C	0.97	17.56	5.52
Dimethyl terephthalate	C	0.42	14.00 [3]	3.33
Chlorinated Hydrocarbons				
Ethylene dichloride	B	0.032	2.78	1.15
Miscellaneous				
Methanol	B	0.02	1.98	1.01
Acetaldehyde	B & C	0.15	9.00*	1.67
Acetic acid	C	0.41	5.71	7.18
Ethylene oxide	B	0.03	7.12	0.42
Ethylene glycol	C	0.48	6.40	7.50
Acetone	C	0.10	3.94	2.54
Oxo chemicals	C	0.43	11.00 [3]	3.91
Phenol	C	0.21	6.56	3.20
Aniline	C	0.50	11.19	4.47
Para-cresol	C	3.50	42.00*	8.31

1) from Table 2

2) Average sales price as derived from U. S. Tariff Commission preliminary "Synthetic Organic Chemicals" - 1971 and assuming price constant through 1972 because of price freeze, except where asterisks (*) price is that listed in June 26, 1972 Chemical Marketing Reporter, using lowest price quoted.

3) Arthur D. Little, Inc., estimates.

chemical industry has been put in that position because competitive pressures – more efficient producers, lower-cost imports, or other chemical or nonchemical alternatives – have precluded passing on increases in production costs. Hence we combined both factors in our judgment evaluation of chemicals or classes of chemicals with a potential water pollution impact and used a scale of 1 to 3 to grade the economic impact; for this we took 1972 as an average year and 6-7% as an average after-tax profit return on total capital employed.

A profitability index of 1 (Table 4) implies that the product enjoys above average margins and can, in general, pass on a large portion of increased costs without adversely affecting its market prospect. A profitability index of 2 implies the product has average industry margins and will have limited opportunity to pass on a major share of added costs without jeopardizing its market. A product with a profitability index of 3 is under severe competitive pressure, has profit margins below the average of the industry, and cannot pass on its increased cost in the face of competition from more efficient producers, imports or alternative products.

The results are shown in Table 4, as well as an abatement cost index for those products for which we have sufficient data to estimate water pollution control costs. These two indices combined give us a rough, but we believe valid, economic impact index.

Of the 70 products or classes of products considered as representative of about 75% of the value of sales of the organic chemical industry, approximately half are in categories A&B and hence face a minimal dislocation in meeting the proposed guidelines of 95% removal using best practicable control technology currently available. The other half, in categories C&D, as listed in Table 4, are all vulnerable to a significant degree in meeting the proposed guidelines. Of those 36 products in this group, we have estimates of abatement cost for only 17 products. Of these, about seven face a difficult problem either because of high abatement costs, a poor market picture or a combination of both. These products are discussed in further detail below. However, prior to discussing these products, it must be emphasized that we believe other products or classes of products listed in Table 4 face a significant problem, even though we do not have the cost data to back up our belief. In our judgment these include coal tar products, ethyl cellulose, dyes and organic pigments, and possibly some unformulated pesticides.

Ethylene Glycol. Ethylene glycol normally is made from ethylene oxide produced in the same complex. About half of the production goes directly to the automotive antifreeze market and a third to polyester fiber, films and resins. The balance is consumed in numerous small uses. Because prices for ethylene oxide have been depressed in the recent past, little new capacity has been added and ethylene glycol supply will be tight for the next few years, and prices are expected to improve. Although raw material and energy costs are expected to rise significantly in addition to the cost of pollution control, we expect that a good portion of the latter cost can be passed on to customers, particularly in antifreeze. Any plant closings will probably be restricted to the older small-capacity plants that account for about 5% of current capacity.

TABLE 4

PROFITABILITY AND IMPACT ON SPECIFIC ORGANIC CHEMICALS
BEST PRACTICABLE WATER POLLUTION CONTROL TECHNOLOGY CURRENTLY AVAILABLE
(95% REMOVAL)

Product	Profitability Index 1)	Abatement Cost Index 2)	Economic Impact Index 3)
Basic Organic Chemicals			
Coal Tar	3		
Large Volume Intermediates			
Resin Intermediates			
Vinyl Chloride	2	2	4
Ethyl Acrylate	1	3	3
Methyl Methacrylate	1	2	2
Vinyl Acetate	2	2	4
Fiber Intermediates			
Acrylonitrile	2		
Adipic Acid	1		
Caprolactam	2	3	6
Dimethyl Terephthalate	1	2	2
Chlorinated Hydrocarbons			
Ethylene Dichloride	2	2	4
Miscellaneous Derived from C_1			
Methanol	3	2	6
Pentaerythritol	2		
Miscellaneous Derived from C_2			
Acetaldehyde	2	2	4
Acetic Acid	2	3	6
Acetic Anhydride	2		
Ethylene Oxide	3	1	3
Ethylene Glycol	3	3	9
Tetraethyl Lead	1		
Ethanol	2		
Ethyl Cellulose	1		
Miscellaneous Derived from C_3			
Isopropanol	3		
Isocyanates	2		
Propylene Oxide	2		
Propylene Glycol	2		
Acetone	3	2	6
Miscellaneous Derived from C_4			
Methyl Ethyl Ketone	2		
Miscellaneous Derived from Aromatics			
Oxochemicals	2	2	4
Phenol	3	2	6
Aniline	2	3	6
Bisphenol A	2		
Para-cresol	1	4	4

TABLE 4 (Continued)

	Profitability Index [1]	Abatement Cost Index [2]	Economic Impact Index [3]
Small-Volume Intermediates & End-Product Organics			
Dyes & Organic Pigments	2		
Rubber Processing Chemicals	1		
Flavors & Fragrances	1		
Unformulated Pesticides	1		
Plasticizers	3		

1) 1 = Product had better than industry average profitability in 1972.
2 = Product had industry average profitability in 1972.
3 = Product had below industry average profitability in 1972.

2) Abatement cost as percent of sales cost based on Table 3.

1 = less than 1%
2 = 1 to 4%
3 = 4 to 8%
4 = 8 to 12%
5 = more than 12%

3) Abatement cost index X profitability index.

Ethylene Dichloride (EDC). The major use for ethylene dichloride is as an intermediate in vinyl chloride monomer (VCM) production. Well over 80% of production is used captively in complexes that produce ethylene and chlorine and make vinyl chloride monomer. In fact, in many instances it is not directly isolated and hence not reported in production figures. EDC is a convenient method of transporting chlorine and can expect to remain important in export for this reason. EDC and vinyl chloride monomer are in short supply and can be expected to remain so, at least through 1975. We would expect some plants to be retired as new capacity comes on-stream in 1975, 1976, and 1977.

The pollution abatement costs are not high, and we doubt that any plants will be closed for this reason alone, because EDC is an integral part of vinyl chloride production, which represents a substantial additional investment. In most cases pollution costs will be included in the transfer price of EDC to VCM, and will be passed on to VCM users at least in part. Because it takes about 1.72 pounds of EDC to produce a pound of VCM, the total water abatement cost carried by VCM will be 0.135¢/lb, equal to 3.2% of the 1972 sales price. It is unlikely that more than half this cost can be passed on in view of the fact that higher raw material costs will also be forcing the price of VCM to higher levels and threaten polyvinyl chloride's market share in competition with other plastics as well as competing metals and wood products. These higher prices will contribute to slowing the growth of VCM from a growth rate of about 14% per year during the last decade to a level closer to 10% in the foreseeable future, a growth rate still substantially above the 8 to 8-1/2% average annual increase in volume experienced by the entire organic chemicals industry.

Caprolactam. Caprolactam is used primarily as a raw material for nylon 6. We expect that costs of water pollution abatement will be passed on by the four caprolactam producers through the nylon 6 prices.

Methanol. Methanol's chief market is formaldehyde, frequently produced at a separate location. About 40% goes to this use, with dimethyl terephthalate the second most important market. During the last two years, prices have dropped from 25¢ per gallon to a low of 10¢ per gallon; prices have risen slightly since that low was reached in 1972. The precipitous drop in price was due to new plant construction coming on-stream with capacity equal to over 50% of total demand. Many older smaller plants can be expected to close down. While pollution control may hasten their closing, it will not be the primary cause. Producers are all large companies.

Acetic Acid. The production of cellulose acetate and vinyl acetate accounts for about three-fourths of acetic acid demand. All is produced by large companies in production complexes. Acetic acid is essential in its major uses; hence direct substitution is unlikely, although the major end products, cellulose acetate and vinyl acetate, may be vulnerable to substitution if pollution abatement costs of their own plus that of acetic acid are passed on to customers. With one exception it is unlikely that plants will be closed since most of the smaller ones produce acetic acid as a by-product of other chemicals.

Acetone. Acetone goes to many uses, including methyl methacrylate, cellulose acetate, bisphenol A, and many solvent applications. Half of the total capacity is produced in cumene process plants which has as a co-product, phenol. Small cumene plants, of which there are four, will be vulnerable to closure through the combined effects of scale efficiencies and pollution abatement costs for both phenol and acetone.

Phenol. Phenolic resins account for about half of phenol's markets. Caprolactam and bisphenol A are two other major markets. Since the major share of production is made via the cumene process, the total cost for the acetone/phenol will be allocated according to each company's policy. In general, we believe most of the costs due to water pollution abatement will be passed on to subsequent products and users except where noted under acetone above.

Aniline. Aniline's primary markets are in rubber processing chemicals, dyestuffs and increasingly in isocyanates, all products affected by the suggested water pollution guideline. Yet aniline is a critical component in all these products, and we anticipate the costs will be passed on without major dislocation in market growth or producing plants.

Coal Tar Products. Coal tar and its distillation products go into a variety of products – light oil distillates such as benzene, toluene, xylene, and solvent naphtha, and the heavy fractions – naphthalene, tar acids, cresylic acid, creosote, tar and pitch. The main pollution problem resides in the heavy fractions, the tar derivatives. The industry has been beset by many problems, a shrinking coal tar raw material as town gas plants closed down and steel mills used the tar captively as a low-sulfur fuel, loss in markets for naphthalene as synthetically made orthoxylene took over much of the phthalic anhydride market, price pressure from petroleum based pitches and lower-priced imports. With margins already depressed, in anticipation of the combined cost of federal and state and water pollution abatement and OSHA, at least three plants will be closed this year. More closures, especially of small isolated plants, can be expected over the next few years. This product area should receive a more detailed review by EPA.

Ethyl Cellulose. A special technical problem faces ethyl cellulose. It is manufactured from wood pulp fiber by a process which depends on the difference in solubility of the product in hot and cold water. Losses of product due to its solubility impose unusually high loads on the bioxidation system. While its profitability has been above average in the past, and its markets relatively price insensitive, we do not know how much it will cost to meet the proposed water pollution abatement guidelines.

Dyes and Organic Pigments. This group of organic chemicals consists of more than a dozen major classes of dyes and pigments consisting of more than a thousand different dyes produced in the United States. About two-thirds of the production goes to the textile industry, another sixth is used in paper production, and the balance is used mainly in leather and plastics. There are about 60 producers in the United States; many of them are small and many are located in urban or suburban areas of New Jersey.

While prices have risen by over 10% in the last five years, in contrast to many more basic organic chemicals, the profit margins of the small nonintegrated dye producers are slim. Foreign imports have been equivalent to over 10% of U.S. production, and a small number of U.S. and foreign controlled firms account for a major share of domestic sales. Furthermore, shifts in textile fashions – materials and colors – make those producers of a limited line of dyes vulnerable to erratic sales demand.

Many of the dyestuff producers in urban and suburban areas put their effluent into municipal sewer systems. No guidelines have been published for present plants dumping into municipal sewer systems, so we cannot comment on their potential vulnerability. It is likely, however, that the pretreatment standards which will ultimately be promulgated will affect expansion in built-up areas more because of limited space than any other reasons. Those small dyes and pigment producers located in rural areas and not currently using municipal systems will be faced with a potential problem.

We have insufficient data to estimate the extent of potential impact, but recommend this be reviewed by the EPA in further detail. The data offered by the Development Document can be used to make an arithmetic calculation of the cost of abatement for dyes and pigments. At the low end of the range, the result is a low cost (¢/lb) at a high hydraulic load. We have not included this calculation because it leads one to a probable erroneous conclusion that the industry has a minimal problem. As stated above, we regard it more likely that a number of smaller producers have a serious problem that will require individual consideration.

Unformulated Pesticides. These products are used in making insecticides, herbicides, fungicides, and other biologically active compounds for agricultural, home, health, and commercial uses. Many scattered small plants, particularly in the Midwest, many of them in rural areas, may face special problems. We have no effluent abatement costs for this segment of the organic chemical industry, but believe this area deserves a more detailed review by the EPA.

Extrapolating the Economic Impact of Water Pollution Control From the Specific to the General. We recognize the hazard of trying to draw general conclusions on the basis of very limited data, but will attempt to do so in this section. All of our comments are confined to the economic impact of the initial level – best practicable technology currently available – to be met by the organic chemical industry by 1977 and are based on the assumption that the water pollution abatement costs given to us by the EPA are accurate except where noted above. In view of the lack of data, we can make no comments regarding advanced levels.

Our coverage of about 75% of the value of the organic chemical industry's sales and the Development Document's coverage of about 75% of the industry's volume of production imply a conservative three-fourths coverage of the total organic chemical industry. Of that 75% covered, we found about half (both in number and sales value) was in Categories A&B. We assume, for the purpose of this study only, that the other 25% not identified has characteristics common to those covered in our work.

Water Pollution Abatement Operating Costs. On that basis, about half of 1972 sales of about $8 billion of organic chemicals have nominal water pollution abatement problems with costs equivalent to about 1% of sales value, that is, about $40 million annually. The other half, Draft Development Document Categories C&D, have in varying degrees a significant economic impact.

The cost of water abatement to achieve 95% removal with best practicable control technology currently available (shown in Table 3) had a weighted average of 3.86% of sales value, with a range from 0.42% to 8.31% of sales value. Mindful of the fact that total after-tax profits averaged 6-7% of capital employed and about 5% of sales in 1972, there would be a very serious economic impact if the industry were not able to pass these costs on to their customers. In any event, costs for this half of the industry are estimated at about $154 million annually, for a total industry cost, on the basis of 1972 sales, of $194 million per year when it is fully meeting suggested 1977 guidelines. As will be seen below, we believe this to be a minimum cost figure, with a figure of $590 million annually a maximum.

Impact on Profits. While the organic chemical industry will be under severe cost pressures because of increased prices for its hydrocarbon raw materials and energy as well as air, water, solid waste pollution control and OSHA, we estimate, purely on judgment, that it will be able to pass on about two-thirds of the minimum cost figures incurred in water pollution abatement. Again on the basis of 1972 values, the industry would have to absorb about $64 million of the cost. Assuming a 50% tax rate, this would represent a depression of after-tax earnings of about 8% per year for the industry when it is fully meeting 1977 requirements.

In our maximum estimate of $590 million annual cost, we question whether the industry would be able to pass on more than one-half of these total costs because of more efficient producers and fear of losing market share to competitive products and/or imports, and would have to absorb $295 million. As 1972 net after-tax profits for the industry were about $400 million, the maximum absorbed costs would depress earnings by 37% of the 1972 base.

Price Effects. Assuming the organic chemical industry can pass on two-thirds of the minimum cost of abatement, or about $140 million, this represents an average increase in prices of 1.6% over the period 1972-1977, while the maximum of $295 million would represent a rise in price of 3.7% over the period.

Effects on Growth of the Industry. Of course, it must be realized that different products would have different costs, with increases ranging from zero to ten percent or more. Price increases of 1-1/2% over five years will have very minor overall effects on the industry's growth, although again certain products and companies will suffer. Even a maximum increase of 3.7% will not present a major dampener on growth. However, increases due to inflation, raw materials and energy will be much greater and will be the main dampener on demand growth, which will slow below the average growth rate of

8-1/2% per year experienced in the 1960's. We are in no position to estimate how much effect these other factors will have on the organic industry's growth.

Capital Needs and Availability. The 1967 Census of Manufactures made a water usage census in 1968. The organic chemical industry reportedly discharged 2,162 billion gallons of water from a total of 239 establishments consuming water out of an industry total of 665 establishments contacted. (By comparison the 1967 Census of Manufactures tabulated 454 establishments; the discrepancy may be due to including warehouses, distribution facilities and other nonproductive establishments in the industry.) Of this total, 413.3 billion gallons was process water. This process water usage is equivalent to an average discharge per establishment (plant) of 1.73 billion gallons per year or 4.7 million gallons per day.

Although we are not saying a plant with such a discharge exists, since some may have much greater and many lesser water usage, it is a useful figure from which to estimate the fixed capital required by the industry to meet water pollution guidelines using the best practicable control technology currently available.

According to the data supplied to us by the EPA, the capital cost using best practical technology for each category having a volume of 720,000 gallons per day is as shown below. Our estimates of a 4.7-million-gpd plant in each category are also included. The latter are based solely on a 0.7 exponential factoring (not 0.6, because of the need for land).

Category	Best Practicable Technology	720,000 gpd	4,700,000 gpd
A	–	$1,410,000	$ 5,231,000
B	95% removal	$2,538,000	$ 9,416,000
C	95% removal	$8,144,000	$30,214,000
D	90% removal	$1,878,000	$ 6,967,000

On the assumption that the industry's volume is divided about equally among the four categories A, B, C, and D (and from Table 1 this appears reasonable) about 60 establishments in each of the four categories will have to make fixed investments in water treatment facilities. The total capital required on this basis is $3,110 million. However, we assumed facilities already installed would partially fulfill the 1977 needs. From data collected by the Manufacturing Chemists Association[1] we estimate the organic chemical industry already had invested $230 million in water abatement facilities by the beginning of 1972. Hence, total new fixed investment to meet proposed 1977 guidelines will be $2,880 million by 1977, averaging $576 million per year. It does not take into account the cost of developing new processes to reduce the effluent load, which should at least correspondingly reduce the capital needed to treat the effluent.

1. Manufacturing Chemists Association "Environmental Commitment – 1972," June 1972.

The fixed capital invested by the basic chemical industry in the United States in 1972 was $2.18 billion; we estimate the organic chemical industry invested $525 million of the total in that year. Obviously, if the capital cost figure for water pollution abatement is correct, the industry will be hard pressed to raise the capital needed for both nonproductive water pollution abatement facilities and for production units needed to supply the growing demand and replace obsolete units. Furthermore, amortizing this investment alone would be a burden of about $295 million annually, substantially more than the $210 million total water pollution abatement operating cost we cited above, based on the average cost in the Draft Development Document for a very limited number of products. Because annual amortization costs are about half total annual costs, a figure of $590 million per year may be considered as a maximum figure of added cost, while $210 million should be considered the minimum figure. We recommend a more detailed review of this question in any further work undertaken by the EPA.

Plant Closings. Even at the minimum level of water pollution abatement costs for the organic chemical industry, some plants will be closed. These plants, in relation to others in the same product or product line, are the marginal plants, probably old, inefficient, seldom in a complex, and frequently small. The capital cost of putting in pollution abatement facilities may well hasten their closure. Although many of the large companies have such plants, they are more apt to be prevalent in small companies, which make up the bulk of companies, as can be seen in Table 5.

Table 5 is a compilation of the Internal Revenue's 1970 tax returns from 3,287 companies classified by the Internal Revenue in SIC 281, Basic Chemicals. While we have no similar breakdown for the organic chemical industry, it is reasonable to assume a similar profile. Ninety-five percent of these companies had assets of less than $5 million; many of these probably have no plants, but some do. (See Table A-10 of Appendix A.) Within the organic chemical industry 220 establishments of the 665 establishments in the industry employ less than ten people. It is primarily in the small plants owned by small companies that most closures will take place. The industry will be further concentrated in the larger companies.

We cannot estimate the number or location of plant closures, although the tabulation of plants producing the chemicals in categories C and D, the potential serious pollution problems (see Appendix B) give some indication of likely candidates.

Employment Effects. Products made in chemical complexes are less vulnerable than those in isolated locations, since such complexes will have a commonly shared water pollution abatement facility. Because each product must carry its own share of the cost, the complex is not likely to be in jeopardy, although the product may be discontinued. It is likely that the personnel connected with the discontinued operation can be absorbed in other operations in the complex. In the case of isolated plants, they will be unemployed. Although the impact on the individuals and small companies will be substantial, it probably will not be substantial to the communities involved, since in most cases it will be the smaller plants that will close.

TABLE 5

COMPANIES IN THE BASIC CHEMICAL INDUSTRY ACCORDING TO ASSETS

Assets ($1000)	Number of Companies	Percent of Total	Cumulative Percent
0 - 100	1161	35.4	35.4
100 - 250	645	19.6	55.0
250 - 500	539	16.4	71.4
500 - 1,000	387	11.8	83.2
1,000 - 5,000	390	11.8	95.0
5,000 - 10,000	59	1.8	96.8
10,000 - 25,000	36	1.1	97.9
25,000 - 50,000	20	0.6	98.5
50,000 - 100,000	12	0.4	98.9
100,000 - 250,000	15	0.4	99.3
Over 250,000	23	0.7	100.0

Source: Internal Revenue Service - 1970

APPENDIX A

THE ORGANIC CHEMICAL INDUSTRY

Definition of the Industry

For the purpose of this study, the organic chemical industry is defined as primary producers of products listed in Standard Industrial Classification[1] Industry numbers 2865 (formerly 2815), "Cyclic (coal tar) Crudes, and Cyclic Intermediates, Dyes, and Organic Pigments (Lakes and Toners)," and SIC number 2869 (formerly 2818) "Industrial Organic Chemicals, not elsewhere classified," with minor modifications.

To make the results of this study more meaningful, it was desirable to break down these two major SIC numbers into smaller segments. We have developed a grouping of chemicals into four major segments and eleven subsegments. See Table A-1. In making these groupings we have taken into consideration four major factors: (1) the naturally occurring business segmentation, (2) the availability of statistics, largely those of the Bureau of the Census and the U.S. Tariff Commission, (3) a commonality of production economics based on process and scale, and (4) compatibility with four basic water effluent treatment categories established by the EPA.[2] In an industry as diverse as organic chemicals, it is difficult to satisfy the four major factors listed above without some compromises and omissions. Nevertheless the breakdown shown in Table A-1 is a realistic segmentation of the industry, and sales from this grouping account for 55% to 60% of total shipments and 75% to 80% of commercial shipments (sales), as estimated by the U.S. Bureau of the Census. (Based on commercial shipments being 77.5% of total shipments or $6.576 billion in 1970 versus $4.947 billion accounted by our industry segmentation.[3])

The Size of the Industry

In the absence of any better statistics, we must depend upon the data provided by the Bureau of the Census and U.S. Tariff Commission. Even these data must be accepted with reservation; generally they have errors of omission.

The Organic Chemical Industry consists of those establishements (plants or parts of plants) classified as primarily producers of Cyclic Intermediates and Crudes and of Industrial

---

1. See pages 121-123 of "Standard Industrial Classification Manual," Statistical Policy Division, Office of Management & Budget, Executive Office of the President, GPO 1972.

2. Category A – Non-aqueous processes; Category B – Process water contact as steam diluent and/or absorbent; Category C – Aqueous liquid-phase reaction system; and Category D – Batch and semi-continuous processes.

3. See Tables A-3 and A-4.

TABLE A-1

ORGANIC CHEMICAL INDUSTRY SEGMENTS

A. Basic Organic Chemicals

1. Coal Derived Basics (Tar & Tar Crudes) SIC 28155

Coal tar acids
Coal tar crudes
Coal tar distillates
Benzene
Toluene
Xylene
Naphtha solvents
Naphthalene
Anthracene
Creosote
Cresols
Cresylic acid
Pitch
Tar

2. Petroleum Derived Basics - Part of SIC 2818 & 2815

Acyclic

Ethylene
Propylene
Acetylene
Butadiene

Cyclic

Benzene
Toluene
Xylene

B. Large Volume Intermediates and Finished Organics Including:

3. Resin Intermediates - Part of SIC 2815 & 2818

Ethyl benzene & styrene
Vinyl chloride
Ethyl acrylates & methylmethacrylates
Vinyl acetate

TABLE A-1 (continued)

4. Fiber Intermediates - Part of SIC 2818 & 2815

Cyclohexane
Acrylonitrile
Adipic acid
Hexamethylene diamine & tetramine
Caprolactam
Dimethyl terephthalate

5. Chlorinated Hydrocarbons - Part of SIC 2818

Methyl chloride
Methylene chloride
Chloroform
Carbon tetrachloride
Ethyl chloride
Ethylene dichloride
Trichloroethylene
Perchloroethylene
Methyl chloroform
Fluorinated hydrocarbons

6. Miscellaneous Generally Derived From: Part of SIC 2815 & 2818

C_1	C_2	C_3	C_4	Aromatics
Methanol	Acetaldehyde	Glycerin		Cumene
Formaldehyde	Acetic acid	Isopropynol		Phenol
Pentaerythritol	Acetic anhydride	Isocyanates		Acetone
Phosgene	Ethanol		Methyl ethyl ketone	Aniline
	Ethyl cellulose	Propylene oxide		Bisphenol
	Ethylene oxide and glycol	Propylene glycol		Phthalic anhydride
		Acetone		
	Tetraethyl lead			

C. Small Volume Intermediates and End Product Organics

7. Dyes & organic pigments SIC 2815 2 & 3
8. Rubber processing chemicals SIC 28183 31
9. Flavors & fragrance SIC 28183 11
10. Unformulated pesticides SIC 2818 4
11. Plasticizers SIC 28183 51

D. Miscellaneous Intermediates

Organic Chemicals n.e.c. In addition, they produce other secondary products classified in other industries; similarly, other industries produce some organic chemicals. The dimensions of the industry can be seen from the value of shipments for 1967 (Table A-2), the latest year for which detailed statistics are available.

Total shipments of organic chemicals equalled $7,193.6 million in 1967. Commercial shipments in that year are estimated by the Bureau of the Census at about $5,560 million, or 77.5% of total shipments. Commercial shipments are about 88% of the $6,325 million sales reported by the U.S. Tariff Commission in 1967.[4] The difference in all shipments from Tariff Commission's reported sales is due primarily to intracompany (plant or plant section) transfer of material for further processing. The Census' lower commercial shipments can be explained by differences in classifications, for example, including coke oven operations, not just tar distillers in the Tariff statistics. The former are omitted from the Census statistics.

Total shipments of organic chemicals for other years are shown in Table A-3, while Table A-4 shows the sales of organics that are included within the segmentation of the industry as used in this report, and Tables A-5 and A-6 yearly sales value and production volume of the segments for 1963-1971. On the assumption that 1972 shipments rose about 12% above those in 1971, total industry shipments would be nearly $10 billion in that year, with commercial shipments on sales about $7.75 billion. Rounding this figure off to the nearest billion because of inadequate statistics we assume in this report that organic chemical industry sales in 1972 were $8 billion.

Characteristics of the Industry

Companies. About 454 companies produce organic chemicals; they operate a total of 665 establishments. The four largest companies account for a minimum of 36% of the industry's shipments and the hundred largest companies account for over 92% of all shipments. (See Table A-7.) The U.S. Tariff Commission in 1970 identified 281 companies as producers of chemicals in segments of the industry. (See Table A-8.)

Companies producing chemicals in five or more of the twelve segments are listed in Table A-9. Tables A-8 and A-9 are based on U.S. Tariff Commission data and hence probably omit some producers. Furthermore, the miscellaneous segment, which accounts for about one-quarter of all sales, has not been included. While many companies in other segments also produce miscellaneous chemicals, a small number produce only these miscellaneous products and they are missing from the list.

Establishments. The Bureau of the Census defines an establishment as "producing a single product or more or less closely related group of products." Within the cyclic intermediates, dyes, organic pigments (lakes and toners) and cyclic (coal tar) crudes and

---

4. See 1967 Census of Manufactures MC 67(2)-28A-2.

TABLE A-2

THE DIMENSIONS OF THE U. S. ORGANIC CHEMICAL INDUSTRY 1967

(millions of dollars)

Total Shipments	By Establishments Classified Primarily In:		Subtotal	By Establishments In Other Industries	Total
	Cyclic Intermediates and Crudes (SIC 2865)	Industrial Organic Chemicals n.e.c. (SIC 2869)			
Cyclic Intermediates & Crudes	1,092.1	360.2	1,452.3	201.9	1,654.2
Industrial Organic Chemicals	168.4	4,461.2	4,629.6	909.8	5,539.4
Other Products & Service Not Included in Above SIC	336.3	1,556.4	1,892.7		
Total Shipments	1,596.8	6,377.8	7,974.6		
Value of All Organic Chemical Shipments					7,193.6

Source: U. S. Bureau of the Census MC 67(2)-28A

TABLE A-3

VALUE OF SHIPMENTS OF ORGANIC CHEMICALS

(millions of dollars)

A. BY ALL MANUFACTURERS

Year	Cyclic Intermediates and Crudes	Industrial Organic Chemicals n.e.c.	Total
1947	444.9	965.9	1,410.8
1954	778.7	2,027.5	2,806.2
1958	893.8	2,787.3	3,681.1
1963	1,195.2	4,183.8	5,379.0
1964	1,277.0	4,457.1	5,734.1
1965	1,452.0	5,023.3	6,475.3
1966	1,591.1	5,366.1	6,957.2
1967	1,654.2	5,539.4	7,193.6
1968	1,786.9	6,056.8	7,843.7
1969	1,896.3	6,356.0	8,252.3
1970	2,014.4	6,470.4	8,484.8
1971	2,077.5	6,814.8	8,892.3

B. BY ALL MANUFACTURERS IN SIC 2815 AND 2818

SIC No.		1971	1970	1967
2815	Cyclic intermediates & crudes	(2,077.5)	(2,014.4)	(1,654.2)
28151	Cyclic intermediates	1,308.9	1,308.8	1,066.1
28152	Synthetic organic dyes	434.7	397.4	325.6
28153	Synthetic organic pigments, lakes & toners	178.2	169.1	162.2
28155	Cyclic (coal tar) crudes	110.9	100.3	87.6
28150	Cyclic intermediates & crudes, nsk	44.8	38.8	12.7
2818	Industrial organic chemicals, n.e.c.	(6,814.8)	(6,470.4)	(5,539.2)
28181	Miscellaneous cyclic chemical products	393.4	371.2	315.1
28182	Miscellaneous acyclic chemicals & products	4,696.7	4,525.6	4,052.2
28183	Synthetic organic chemicals (except surface active)	785.5	718.7	585.6
28184	Pesticides and other unformulated organics	387.1	331.2	308.2
28185	Ethyl alcohol and other industrial organic chemicals	492.1	466.2	239.4
28180	Industrial organic chemicals, nsk	60.0	57.5	38.7

Source: Bureau of the Census

TABLE A-4

ORGANIC CHEMICAL INDUSTRY

SALES VALUE FOR 1967 & 1970

(millions of dollars)

	1970		1967		Average Price ($/lb) 1970	Average Price ($/lb) 1967
A. Basic Organic Chemicals		870		728	.031	.036
1. Coal Derived Basics		178		132		
2. Petroleum Derived Basics		692		596		
a) acyclic	419		363			
b) cyclic	273		233			
B. Large Volume Intermediates and Finished Organics		2,221		1,879	.076	.092
1. Resin Intermediates		368		278		
2. Fiber Intermediates		345		236		
3. Chlorinated Hydrocarbons		407		338		
4. Miscellaneous		1,101		1,027		
C_1	104		95			
C_2	463		520			
C_3	133		120			
C_4	39		41			
Aromatics	362		251			
C. Small Volume Intermediates and End Organics		1,856		1,713	.685	.659
1. Dyes & Organic Pigments		513		440		
2. Rubber Processing Chemicals		149		132		
3. Flavors and Fragrances		89		93		
4. Unformulated Pesticides		870		787		
5. Plasticizers		235		261		
D. Miscellaneous Intermediates		?		?		
Total		4,947*		4,320*		

* Excludes Miscellaneous from Total

Source: U. S. Tariff Commission, Synthetic Organic Chemicals, U. S. Production and Sales.

TABLE A-5

ORGANIC CHEMICAL INDUSTRY

SALES VALUE

(millions of dollars)

	1963	1964	1965	1966	1967	1968	1969	1970	1971*
A. Basic Organic Chemicals	529	579	648	747	728	737	815	870	833
1. Coal Derived Basics	121	129	139	139	132	138	178	178	159
2. Petroleum Derived Basics	408	450	509	608	596	599	637	692	674
B. Large Volume Intermediates and Finished Organics	1,549	1,684	1,764	1,890	1,879	2,023	2,198	2,221	2,208
3. Resin Intermediates	222	250	243	273	278	312	359	368	384
4. Fiber Intermediates	148	185	226	243	236	299	362	345	329
5. Chlorinated Hydrocarbons	265	292	317	339	338	339	389	407	409
6. Miscellaneous	913	958	979	1,035	1,027	1,073	1,089	1,101	1,086
C. Small Volume Intermediates and End Products	1,053	1,170	1,305	1,500	1,713	1,867	1,873	1,856	2,033
7. Dyes and Organic Pigments	320	348	386	439	440	490	518	513	553
8. Rubber Processing Chemicals	119	123	123	138	132	151	144	149	159
9. Flavors and Fragrances	77	84	85	93	93	97	94	89	84
10. Unformulated Pesticides	369	427	497	584	787	849	851	870	979
11. Plasticizers	168	188	214	246	261	280	266	235	258
Grand Total Accounted for:	3,131	3,433	3,717	4,137	4,320	4,627	4,886	4,947	5,074
D. Miscellaneous Intermediates									

Note: Totals do not add up due to rounding.
*Preliminary

Source: U. S. Tariff Commission, Synthetic Organic Chemicals, U. S. production and sales.

TABLE A-6

ORGANIC CHEMICAL INDUSTRY

PRODUCTION VOLUME

(billions of pounds)

	1963	1964	1965	1966	1967	1968	1969	1970	1971*
A. Basic Organic Chemicals	27.9	31.6	34.9	38.9	41.6	46.1	56.9	58.1	57.9
1. Coal Derived Basics	5.5	5.8	6.2	6.0	5.6	6.0	12.1	11.6	10.1
2. Petroleum Derived Basics	22.4	25.8	28.7	32.9	36.0	40.1	44.8	46.5	47.8
B. Large Volume Intermediates and Finished Organics	34.1	39.0	43.0	49.6	50.8	58.0	66.5	69.3	69.9
3. Resin Intermediates	6.2	7.9	8.8	9.9	10.1	12.0	14.7	14.7	15.6
4. Fiber Intermediates	3.1	3.7	4.6	5.9	5.3	6.7	7.4	6.6	7.1
5. Chlorinated Hydrocarbons	4.4	5.0	5.7	7.1	7.6	8.7	10.5	12.2	12.2
6. Miscellaneous	20.5	22.4	24.0	26.6	27.8	30.7	34.0	35.8	35.0
C. Small Volume Intermediates and End Products	2.1	2.3	2.6	2.9	2.9	3.2	3.2	3.1	3.4
7. Dyes and Organic Pigments	.2	.2	.3	.3	.3	.3	.3	.3	.3
8. Rubber Processing Chemicals	.2	.3	.3	.3	.3	.3	.3	.3	.3
9. Flavors and Fragrances	.1	.1	.1	.1	.1	.1	.1	.1	.1
10. Unformulated Pesticides	.8	.8	.9	1.0	1.1	1.2	1.1	1.0	1.1
11. Plasticizers	.8	1.0	1.1	1.2	1.3	1.3	1.4	1.3	1.5
Grand Total Accounted for:	64.1	72.9	80.5	91.4	95.3	107.3	126.6	130.5	131.2
D. Miscellaneous									

Note: Totals do not add up due to rounding.
*Preliminary

Source: U. S. Tariff Commission, Synthetic Organic Chemicals, U. S. production and sales.

TABLE A-7

CONCENTRATION OF THE ORGANIC CHEMICAL INDUSTRY 1967

	Companies	Establishments		Value of Shipments		Number of Employees		Production Workers	
		No.	%	$ MM	%	thousand	%	thousand	%
Cyclic Intermediates & Crudes - SIC 2865 (formerly 2814 & 2815)									
Total industry	115	177		1,596.8		30.0		20.3	
4 largest companies		21	12	719	45	13.2	44	9.3	46
8 largest companies		44	25	1,021	64	18.0	60	12.4	61
20 largest companies		71	40	1,326	83	24.5	83	17.1	84
50 largest companies		110	62	1,550	97	28.8	96	19.7	97
Industrial Organic Chemicals, NEC - SIC 2869 (formerly 2818)									
Total industry	339	488		6,377.8		95.1		62.4	
4 largest companies		29	6	2,868	45	40.0	42	26.8	43
8 largest companies		49	10	3,700	58	50.4	53	34.3	55
20 largest companies		98	20	4,770	75	67.5	71	44.2	71
50 largest companies		175	36	5,860	92	83.7	88	54.9	88

Source: Bureau of the Census, 1967 Census of Manufactures, Concentration Ratios in Manufacturing - MC67(S)2.1, 2 & 3.

TABLE A-8

ORGANIC CHEMICAL INDUSTRY

PRODUCING COMPANIES – 1970

A.	Basic Organic Chemicals		71
	1. Coal Derived Basics	14	
	2. Petroleum Derived Basics	60	
B.	Large Volume Intermediates		101
	1. Resin Intermediates	38	
	2. Fiber Intermediates	26	
	3. Chlorinated Hydrocarbons	24	
	4. Miscellaneous	67	
C.	Small Volume Intermediates		185
	1. Dyes and Organic Pigments	56	
	2. Rubber Processing Chemicals	27	
	3. Flavors and Fragrances	49	
	4. Unformulated Pesticides	78	
	5. Plasticizers	54	
	Total		281

Note: Totals do not represent additions. Companies have not been double counted.

If a category is manufactured in more than one division of a company, the reference is to the company and not to the individual division.

Does not include producers of miscellaneous intermediates.

Source: U. S. Tariff Commission, Synthetic Organic Chemicals, U. S. Production and Sales, 1970 - TC Publication 479.

TABLE A-9

COMPANIES MANUFACTURING SIX OR MORE CATEGORIES *

Company Name	Basic Organics		Large Volume				Small Volume					Total
	Coal Derived Basics	Petroleum Derived Basics	Resin Intermediates	Fiber Intermediates	Chlorinated Hydrocarbons	Miscellaneous	Dyes and Organic Pigments	Rubber Processing Chemicals	Flavors and Fragrances	Unformulated Pesticides	Plasticizers	
Allied Chemical Corp.	X	X	X	X	X	X	X	X	X	X	X	11
American Cyanamid Co.			X	X	X	X	X	X		X	X	8
B. F. Goodrich Chemical Company		X	X	X	X			X		X	X	7
Dow (-Badische, -Corning) Chemical Co.		X	X	X	X	X			X	X	X	8
E. I. du Pont de Nemours & Co., Inc.		X	X	X	X	X	X	X		X	X	9
Eastman Kodak Co.		X				X	X	X	X		X	6
FMC Corp.					X	X	X	X		X	X	6
Hercules, Inc.					X	X	X		X	X	X	6
Monsanto Company		X	X	X		X		X	X	X		7
Tenneco Chemicals, Inc.			X	X		X	X		X	X		6
Union Carbide Corporation		X	X	X	X	X			X	X	X	8

* Except miscellaneous

industrial organic chemicals, not elsewhere classified, which is the SIC classification used to define the organic chemicals industry, there are about one dozen closely related groups. As the organic chemical industry is, in general, highly integrated, many large plants produce one or more closely related groups; quite frequently, therefore, a plant may, in Census terms, consist of more than one establishment.

Table A-10 shows the size distribution (by employment) of the establishments in the organic chemical industry as of 1967. The number of establishments and employees in 1972, our base year, is not significantly different from 1967, because the industry's normal growth, particularly in employment, was halted and reversed during the recession of 1970/71. The geographic distribution of the industry is shown in Table A-11. The Middle Atlantic and West South Central states together account for 46% of the establishments and 54% of employees in the organic chemical industry.

Growth of the Industry. Over the last decade those companies whose primary production is in cyclic intermediates grew at a rate of about 6% per year, a slower rate than in industrial organics, n.e.c. The average growth in sales for both together between 1958 and 1972 was 7-1/2% per year. (See Table A-12.) The industry is maturing; hence, despite any impact of pollution control, the industry's average rate of growth can be expected to continue to decline. The impact of pollution control and the availability and cost of hydrocarbons and energy will, if anything, accelerate that decline in growth rate.

In a very real sense, the value of shipments does not reflect the increase in physical volume. Unlike many industries, where inflation and price increases overstate the growth of the industry, the decline in prices of organic chemicals understates the rate of growth in physical volume. As can be seen from the last column of Table A-12, the physical volume of shipments of the organic chemical industry grew at a rate of about 8-1/2% per year between 1958 and 1972.

Prices in the Industry. The Bureau of Labor Statistics collects price information and develops price indices for the chemical industry in connection with the development of the wholesale price index. While these prices are based primarily on list prices, and hence do not take into account the widespread discounting practiced in the chemical industry when capacity utilization is low, the indices do nevertheless represent the best available general indicator of price trends. Tables A-13 and A-14 show this trend from 1958 through 1972. Table A-15, which is based on prices realized and reported to the U.S. Tariff Commission, shows price trends in the segments of the industry since 1963; these trends generally correspond to the price indices.

In general the decline in prices has not been accompanied by a similar decline in cost. While unit labor costs have been held down by improved productivity, the cost of raw materials from outside the industry, the cost of energy, and the cost of construction have risen at a much more rapid rate. The price index for all industrial commodities rose to an average of 117.9 (1967 = 100) during 1972; fuels, related products and power rose to 118.6, and construction materials and components have risen to 126.2 (to say nothing of the cost of erecting plants).

TABLE A-10

ESTABLISHMENT BY EMPLOYMENT SIZE IN THE ORGANIC CHEMICAL INDUSTRY 1967

Establishments by Size (No. of Employees)	Cyclic Intermediates and Crudes (SIC 2815/2865)	Industrial Organic Chemicals, n.e.c. (SIC 2818/2869)	Total
1 - 4	26	125	151
5 - 9	20	49	69
10 - 19	24	46	70
20 - 49	27	69	96
50 - 99	16	50	66
100 - 249	37	70	107
250 - 499	13	38	51
500 - 999	7	21	28
1,000 - 2,499	7	13	20
2,500 or more	0	7	7
Total Establishments	177	488	665
Companies Represented	115	339	454
Total Employees (1000)	30.0	95.1	125.1
Production Workers	20.3	62.4	82.7
Total Payroll ($ million)	251.1	844.9	1,096.0

Source: 1967 Census of Manufactures, Industrial Chemicals 28A.

TABLE A-11

GEOGRAPHIC DISTRIBUTION OF THE ORGANIC CHEMICAL INDUSTRY 1967

	Cyclic Intermediates and Crudes (SIC 2815/2865)		Industrial Organic Chemicals, n.e.c. (SIC 2818/2869)		Total		
	Establishments	Total Employees (1000)	Establishments	Total Employees (1000)	Establishments	Employees (1000)	%
Northeast Region	95	16.6	168	26.6	263	43.2	34.5
New England	17	0.9	36	3.9	53	4.8	
Middle Atlantic	78	15.7	132	22.7	210	38.4	
New York	18	3.1	37	6.0	55	9.1	
New Jersey	43	10.0	75	14.8	118	24.8	
Pennsylvania	17	2.5	20	1.9	37	4.4	
North Central Region	29	6.0	98	17.3	127	23.3	18.7
East North Central	26	6.0	80	14.5	106	20.5	
Ohio	12	1.8	28	2.7	40	4.5	
West North Central	0	0	18	2.9	18	2.9	
South Region	44	7.1	160	47.8	204	54.9	43.9
South Atlantic	20	3.6	55	13.5	75	17.1	
East South Central	10	1.2	25	7.2	35	8.4	
West South Central	14	2.3	80	27.2	94	29.5	
Louisiana	3	n.a.	26	n.a.	29	n.a.	
Texas	11	n.a.	52	18.7	63	18.7+	
West Region	9	0.3	62	3.3	71	3.6	2.9
Total	177	30.0	488	95.1	665	125.1	100.0

Source: U. S. Bureau of the Census

TABLE A-12

VALUE OF SHIPMENTS OF THE ORGANIC CHEMICAL INDUSTRY

(millions of dollars)

	Cyclic Intermediates and Crudes (SIC 2815/2865)	Industrial Organic Chemicals, n.e.c. (SIC 2818/2869)	Total	Volume of Shipments in Constant 1967 Organic Chemical Dollars (1)
1958	934.4	3,098.0	4,032.4	3,616.5
1959	1,114.8	3,609.2	4,724.0	4,236.8
1960	1,127.2	3,712.9	4,840.1	4,348.7
1961	1,136.2	3,947.2	5,083.4	4,737.6
1962	1,152.0	4,430.1	5,582.1	5,393.3
1963	1,212.8	4,840.2	6,053.0	6,010.9
1964	1,289.6	5,265.3	6,554.9	6,614.4
1965	1,456.3	6,012.5	7,468.8	7,521.5
1966	1,556.3	6,541.1	8,097.4	8,129.9
1967	1,596.8	6,377.8	7,974.6	7,974.6
1968	1,716.1	6,965.8	8,681.9	8,769.6
1969	1,847.9	7,383.0	9,230.9	9,536.1
1970	1,804.0	7,379.7	9,183.7	9,371.1
1971	1,967.6	8,214.3	10,181.9	10,368.5
1972 est.	2,100	8,800	10,900	11,331
Percent average annual growth 1958-1972	6	8	7 1/2	8 1/2

(1) $\frac{\text{Value of Shipments}}{\text{Price Index Organic Chemicals}}$ (See Table A-13)

Sources: U. S. Bureau of the Census 1958-1971; 1972, Arthur D. Little, Inc., estimates.

TABLE A-13

PRICE TRENDS IN THE CHEMICAL INDUSTRY 1958-1972

(1967 = 100)

	Chemicals & Allied Products (SIC 28) 1)	Industrial Chemicals (SIC 281) 1)	Organic Chemicals (SIC 2815 & 2818) 1)	Cyclic Intermediates (SIC 28151)	Misc. Acyclic Chemicals (SIC 28182)
1958	102.0	102.6	111.5		
1959	101.6	102.9	111.5		
1960	101.8	103.2	111.3		
1961	100.7	101.0	107.3		
1962	99.1	98.9	103.5		
1963	97.9	97.3	100.7		
1964	98.3	96.7	99.1		
1965	99.0	97.5	99.3		
1966	99.4	98.3	99.6		
1967	100.0	100.0	100.0	100.0	100.0
1968	99.8	101.0	99.0	95.3	100.0
1969	99.9	100.3	96.8	91.4	91.6
1970	102.2	100.9	98.0	89.7	90.0
1971	104.2	102.0	98.2	86.6	88.7
1972	104.2	101.2	96.2	84.5	86.3

1) While the Department of Labor's classification is different from the Standard Industrial Classification, it corresponds roughly to the SIC numbers shown here.

Note: These indices are based on list prices, hence do not reflect discounts off list prices.

Source: Bureau of Labor Statistics, U. S. Department of Labor.

TABLE A-14

PRICE TRENDS IN THE ORGANIC CHEMICAL INDUSTRY 1958-1972

(1967 = 100)

	Organic Crudes (06-12-01)	Organic Intermediates (06-12-02)	Dyes (06-12-03)	Organic Chemicals n.e.c. (06-12-04)
1958	123.9	121.4	94.9	108.2
1959	120.1	118.9	92.8	110.2
1960	120.6	118.7	93.7	110.5
1961	114.8	118.7	95.8	106.2
1962	107.5	110.6	94.2	102.5
1963	101.4	107.2	89.0	100.5
1964	95.6	103.8	89.4	100.1
1965	96.4	101.5	97.2	99.9
1966	97.0	102.3	100.0	99.3
1967	100.0	100.0	100.0	100.0
1968	99.6	94.2	100.9	99.7
1969	97.8	91.1	104.8	96.9
1970	99.1	90.4	116.3	97.8
1971	103.8	89.4	125.9	96.8
1972	104.4	87.3	128.4	93.9

Note: These indices are based on list prices, hence do not reflect discounts off list prices.

Source: Bureau of Labor Statistics, U. S. Department of Labor.

TABLE A-15

ORGANIC CHEMICAL INDUSTRY

SALES VALUE

($/lb)

	1963	1964	1965	1966	1967	1968	1969	1970	1971*
A. Basic Organic Chemicals	.040	.040	.038	.038	.036	.034	.032	.031	.031
1. Coal Derived Basics	.034	.035	.034	.035	.034	.035	.026	.026	.027
2. Petroleum Derived Basics	.042	.042	.039	.038	.036	.033	.034	.033	.032
B. Large Volume Intermediates and Finished Organics	.110	.102	.098	.094	.092	.084	.078	.076	.073
3. Resin Intermediates	.096	.087	.080	.082	.079	.072	.066	.061	.060
4. Fiber Intermediates	.110	.107	.101	.087	.085	.087	.090	.092	.093
5. Chlorinated Hydrocarbons	.117	.112	.113	.111	.107	.096	.082	.081	.082
6. Miscellaneous	.112	.103	.098	.096	.093	.085	.079	.077	.070
C. Small Volume Intermediates and End Products	.563	.564	.568	.592	.659	.666	.669	.685	.687
7. Dyes and Organic Pigments	1.43	1.63	1.69	1.78	1.82	1.88	1.98	1.90	2.00
8. Rubber Processing Chemicals**	67	.67	.64	.66	.66	.64	.63	.65	.65
9. Flavors and Fragrances**	1.15	1.05	.96	.94	.97	.89	.90	.97	1.25
10. Unformulated Pesticides**	.57	.62	.65	.71	.88	.88	.92	.99	1.03
11. Plasticizers**	.22	.21	.28	.21	.22	.23	.21	.19	.18
Weighted Average of Those Above	.107	.104	.099	.098	.100	.095	.086	.083	.086
D. Miscellaneous Intermediates									

* Preliminary

** As reported by the U. S. Tariff Commission

Source: U. S. Tariff Commission, Synthetic Organic Chemicals, U. S. production and sales.

The cost-price squeeze has, in general, come out of profits. While the level of capacity utilization is a major component of profitability, the average profitability of the basic chemical industry, which is the closest corresponding to the organic chemical industry (but which also includes inorganics, plastics, resins, fibers and fertilizers), has declined substantially since 1964, and the average in the sixties was substantially below those experienced in the 1950's. Table A-16 shows the profitability of the basic chemical industry since 1960.

Water Consumption by the Organic Chemical Industry

The data collected in connection with the 1967 Census of Manufactures on water usage in 1968, insofar as it relates to the organic chemical industry (i.e., SIC 2815 and 2818), is shown in Table A-17.

TABLE A-16

PROFITABILITY OF U. S. BASIC CHEMICAL INDUSTRY

Year	Net Sales ($ billion)	Net Profit [1] ($ billion)	Return on Equity (percent)	Return on Total Capital [2] (percent)
1960	12.7	1.1	11.1	8.6
1961	13.0	1.1	10.5	8.2
1962	14.3	1.2	11.6	8.8
1963	15.8	1.3	12.5	9.2
1964	18.4	1.6	14.2	10.1
1965	20.9	1.7	14.3	9.7
1966	23.6	1.9	14.0	9.5
1967	24.4	1.6	10.9	7.3
1968	26.2	1.7	11.1	7.4
1969	27.1	1.6	10.5	7.0
1970	27.4	1.4	8.6	5.6
1971	29.5	1.5	8.7	5.8
1972	33.2	1.8	10.0	6.7

1) After tax.

2) Total capital employed = long-term debt (+ other nonrecurring liabilities) + stockholders' equity.

Rounding of profits, equity and total capital does not permit checking against above figures.

Source: Securities & Exchange Commission 1960-1972.

TABLE A-17

WATER USAGE, ORGANIC CHEMICAL INDUSTRY 1968

	Cyclic Intermediates and Crudes	Industrial Organic Chemicals, n.e.c.	Total
Value of shipments ($ million)	1,301.7	6,000.5	7,302.2
Value added ($ million)	611.0	3,386.9	3,997.9
Employees of those consuming water (thousands)	25.0	88.0	113.0
Water intake (billion gallons)	139.1	2,140.3	2,279.4
Of which treated prior to use (billion gallons)	16.8	172.3	189.1
Total used including recycled (billion gallons)	366	3,965	4,331
Water use (billion gallons)			
Process	19.3	394.0	413.3
Air conditioning	1.1	24.5	25.6
Steam electric power generation	0.8	483.8	484.6
Other cooling and condensing	107.0	1,180.1	1,287.1
Boiler feed, sanitary & misc.	11.0	57.9	68.9
Water discharged (billion gallons)	129.0	2,033.3	2,162.3
Of which treated prior to discharge	50	142	192
Water discharge, by point of discharge (billion gallons)			
Public utility sewer	4.7	39.2	43.9
Surface water body	56.9	860.4	917.3
Tidewater body	66.7	1,107.9	1,174.6
Ground	0.5	8.4	8.9
Transferred to other uses	0.2	17.4	17.6
	129.0	2,033.3	2,162.3

TABLE A-17 (continued)

WATER USAGE, ORGANIC CHEMICAL INDUSTRY 1968

	Cyclic Intermediates and Crudes	Industrial Organic Chemicals, n.e.c.	Total
Number of establishments treating water prior to recirculation or reuse			
Total establishments consuming water in industry	62	177	239
Total treating water	31	93	124
Of which:			
Aeration	4	14	18
Coagulation	1	8	9
Filtration	6	14	20
Softening	2	12	14
Ion exchange	3	10	13
Corrosion control	24	71	95
pH	19	60	79
Settling	2	15	17
Flotation	-	2	2
Other	4	14	18
Number of establishments treating water prior to discharge			
Total treating water	46	114	160
Of which:			
Coagulation	6	12	18
Settling - Primary	23	57	80
Settling - Secondary	8	21	29
Trickling filters	1	5	6
Activated sludge	7	13	20
Digestion	4	8	12
Ponds or lagoons	17	57	74
pH	29	63	92
Sand filtration	2	2	4
Chlorination	5	13	18
Flotation	10	24	34
Other	16	63	79

Source: 1967 Census of Manufactures, Water Use in Manufacturing MC67(1)-7

APPENDIX B

REGIONAL PLANT LOCATIONS FOR MAJOR ORGANIC CHEMICALS

Notes

1. Standard Metropolitan Statistical Areas (SMSA) including a group of cities (example: Allentown-Bethlehem-Easton, Pa. – N.J. SMSA) are listed by the name of the first city (e.g., Allentown SMSA).

2. When products are made in towns of two different states which belong to the same SMSA, the SMSA is repeated under all states concerned; the products are listed only under that state in which they are produced.

3. Products made in the same plant are joined by a vertical line.

4. Capacities, when available, are listed in parentheses in millions of pounds per year.

Sources

For organic chemical producers by location: *1973 Directory of Chemical Producers, United States of America*, Stanford Research Institute, Menlo Park, California.

For organic chemical producers by location: *Chemical Economics Handbook*, Stanford Research Institute, Menlo Park, California.

For town/city locations by county: *Directory of Post Offices*, United States Postal Service, July 1971.

For SMSA and county components: *Standard Metropolitan Statistical Areas*, Executive Office of the President, Bureau of the Budget, 1967.

KEY TO ABBREVIATIONS OF CHEMICAL PRODUCTS

Abbreviations	Chemicals[1]
AcAc	Acetic Acid
AcAn	Acetic Anhydride
Acet	Acetone
Aceth	Acetaldehyde
Acryl	Acrylonitrile
Adip	Adipic Acid
Anil	Aniline
Anth	Anthracene
Bis A	Bisphenol A
Cap	Caprolactam
CP	Coal Tar Acids Coal Tar Crudes Coal Tar Distillates Pitch Tar
CRE	Creosote
Cresyl	Cresylic Acid
CRL	Cresols
DMT	Dimethyl Terephthalate
D & P	Dyes & Organic Pigments
EC	Ethyl Cellulose
EDC	Ethylene Dichloride
EG	Ethylene Glycol
EO	Ethyl Oxide
EtAcr	Ethyl Acrylates
EtOH	Ethanol
F & F	Flavors & Fragrances
Isc	Isocyanates
Isp	Isopropanol
MEK	Methyl Ethyl Ketone
MMC	Methyl Methacrylates
MeOH	Methanol-Synthetic
Nap	Naphthalene
Naphtha	Naphtha Solvents
OXO	Oxo Chemicals
P-CRL	Para-Cresols
Pent	Pentaerythritol
Pest	Unformulated Pesticides
Ph	Phenol
PG	Propylene Glycol
Pl	Plasticizers

KEY TO ABBREVIATIONS OF CHEMICAL PRODUCTS (Continued)

Abbreviations	Chemicals[1]
PO	Propylene Oxide
RP	Rubber Processing Chemicals
TEL	Tetraethyl Lead
VAM	Vinyl Acetate Monomer
VCM	Vinyl Chloride Monomer

1. From Table 2 of this report.

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC C

NEW ENGLAND STATES

	Connecticut					Ma
	Bridgeport SMSA	New Haven SMSA	New London SMSA	Waterbury SMSA	Non-SMSA Area	Non A
American Hoechst Corporation						
Benzenoid Organics, Inc.						
Childs Pulp Colors, Inc.						
Hampden Color & Chemical Company						
The Humphrey Chemical Company		RP				
I C I America Inc.						
Monsanto Company						
Nyanza Inc.						
Pfizer Inc.			F & F			
Sobin Chemicals, Inc.						P
Solvent Chemical Company, Inc.						
Stepan Chemical Company						
Teknor Apex Company						
Uniroyal, Inc.				Pest RP Anil		
United Merchants & Manufacturers, Inc.						
R. T. Vanderbilt Company, Inc.					RP Pest	
Westville Chemical Corporation	RP					
Woonsocket Color & Chemical Company						

Capacities listed in parenthesis when available in millions of pounds per year.

IONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

NEW ENGLAND STATES

nnecticut			Maine	Massachusetts				Rhode Island
London SMSA	Waterbury SMSA	Non-SMSA Area	Non-SMSA Area	Boston SMSA	Fall River SMSA	Springfield SMSA	Non-SMSA Area	Providence SMSA
								D & P
							D & P	
						D & P		
						D & P		
							RP D & P	
				Pl			Pest	
				D & P				
F & F								
			Pest					
				Pest				
							RP	
								Pl
	Pest RP Anil							
					D & P			
		RP Pest						
								Pest

pounds per year.

	New Jersey									
	Allentown[1] SMSA	Jersey City SMSA	Newark SMSA	Paterson SMSA	Philadelphia[2] SMSA	Wilmington[3] SMSA	Non-SMSA Area	Albany SMSA	Buffalo SMSA	N
Aceto Chemical Co., Inc.				F & F RP						
Akzona Incorporated										
Alan Wood Steel Co.										
Alco Standard Corporation										
Allied Chemical Corporation				D & F					CF D & P	
Amchem Products, Inc.										
American Aniline Products, Inc.										
American Cyanamid Company			RP Pest				RP Anil(60) D & P Pest Pest			
American Polymers, Inc.				EC						
Ashland Chemical Company	Pest						RP			
Atlantic Chemical Industries, Inc.			D & P							
Baychem Corporation		D & P								
Berncolors-Poughkeepsie, Inc.										
Bethlehem Steel Corporation									CP	
Blue Spruce Company							Pest			
Borden Inc.										
Celanese Corporation			Pest							
Chase Chemical Corporation										
Chem-Fleur, Inc.			F & F							
Chempar Chemical Co., Inc.										
Chevron Chemical Company							Pest			
Ciba-Geigy Corporation		D & F	Pes:							
Cincinnati Milacron, Inc.							Pl Pest			
W. A. Cleary Corporation							RP Pest			

1) Pennsylvania share of Allentown SMSA is listed under Pennsylvania; New Jersey share under New Jersey
2) Pennsylvania share of Philadelphia SMSA is listed under Pennsylvania; New Jersey share under New Jersey
3) See Delaware for Delaware share of Wilmington SMSA

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

MID ATLANTIC STATES

	New York						Pennsylvania						
-SMSA rea	Albany SMSA	Buffalo SMSA	New York SMSA	Rochester SMSA	Syracuse SMSA	Non-SMSA Area	Allentown[1] SMSA	Johnstown SMSA	Philadelphia[2] SMSA	Pittsburgh SMSA	Reading SMSA	York SMSA	Non-SMSA Area
									Pl				
									CP Naphtha				
									F & F			Pest	
		CP D & P			CP Pest				Acet(270) Ph(500) F & F Acet				
									Pest				
													D & P
(60) P													
					D & P								
		CP					CP		CP Naphtha				
					Pest								
					Pest								

	New Jersey										
	Allentown[1] SMSA	Jersey City SMSA	Newark SMSA	Paterson SMSA	Philadelphia[2] SMSA	Wilmington[3] SMSA	Non-SMSA Area	Albany SMSA	Buffalo SMSA	New S
Cloray NJ Corp.			F & F							
Commercial Solvents Corp.										
Continental Oil Company			RF							
Cosan Chemical Corporation				Pest						
Crompton & Knowles Corp.										
Diamond Shamrock Chemical Co.		Fl								
Donner-Hanna Coke Corporation										
E. I. du Pont de Nemours & Co., Inc.			Pest		DMI(280) Anil(135) RP Pest	Isc(120) RP D & P			CP	
Dye Specialties, Inc.		D & F								
Eastern Gas and Fuel Associates										
Eastman Kodak Company										
Emkay Chemical Company			Fl							
Evans Chemetics, Inc.										
Exxon Corporation			Acet(120) MEK(210)							
Fabricolor Manufacturing Corp.				D & P						
Fairmount Chemical Co., Inc.				F & F RP						
Felton International Inc.										
Filo Color and Chemical Corp.			Pest Fl							
Fine Organics, Inc.				RP						
FMC Corporation									Pest RP	
Foster-Heaton Company				D & P						
Fritzsche Dodge & Olcott Inc.			Pest F & F							
GAF Corporation		D & P Pest		D & P				D & P F & F		
Gane's Chemical Works, Inc.				Pest						
Givaudan Corporation				F & F Fl						
Glyco Chemicals, Inc.										
The Goodyear Tire & Rubber Co.									RP	

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

MID ATLANTIC STATES (Continued)

New York						Pennsylvania						
Albany SMSA	Buffalo SMSA	New York SMSA	Rochester SMSA	Syracuse SMSA	Non-SMSA Area	Allentown[1] SMSA	Johnstown SMSA	Philadelphia[2] SMSA	Pittsburgh SMSA	Reading SMSA	York SMSA	Non-SMSA Area
						Pest Pent(20)						
										D & P D & P		
	CP											
								CP				
			RP Pl									
					F & F							
		F & F										
	Pest RP											AcAn(60)
D & P F & F												
												Pl
	RP											

	New Jersey							New York		
	Allentown[1] SMSA	Jersey City SMSA	Newark SMSA	Paterson SMSA	Philadelphia[2] SMSA	Wilmington[3] SMSA	Non-SMSA Area	Albany SMSA	Buffalo SMSA	N
W. R. Grace & Co.							Fl			
Guardian Chemical Corporation										
Hercules Incorporated					DMT(75) Pest F-GRL					
Hoffmann-La Roche Inc.			F & F							
Hooker Chemical Corporation									Pest RF Pest	
E. F. Houghton & Company										
Hummel Chemical Company, Inc.							F & F			
Inmont Corporation				D & P						
International Flavors & Fragrances, Inc.							F & F			
Jones & Laughlin Steel Corporation										
Kay-Fries Chemicals Inc.										
Kenrich Petrochemicals, Inc.		RF								
Keystone Color Works, Inc.										
H. Kohnstamm & Co., Inc.					D & P					
Koppers Company, Inc.		CP								
C. Lever Company, Inc.										
Lord Corporation										
MacAndrews & Forbes Co.					F & F					
MacKenzie Chemical Works, Inc.										
Magruder Color Company, Inc.			D & P							
Mallinckrodt Chemical Works		Pest								
Max Marx Color and Chemical Company			D & P							
Otto B. May, Inc.			D & P							
Merck & Co., Inc.				Pest						
Millmaster Onyx Corporation			RF F & F Pest Fl	RF			Fl			
Mobil Oil Corporation							Fl			
Monsanto Company					Fl					

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

MID-ATLANTIC STATES (Continued)

	New York						Pennsylvania						
	Albany SMSA	Buffalo SMSA	New York SMSA	Rochester SMSA	Syracuse SMSA	Non-SMSA Area	Allentown[1] SMSA	Johnstown SMSA	Philadelphia[2] SMSA	Pittsburgh SMSA	Reading SMSA	York SMSA	Non-SMSA Area
			RP			Pest D & P							
		Pest RP Pest	Pl						Pl				
										CP Naphtha CP			
			Pl									D & P	
			D & P						D & P				F & F
			Pest										RP
													Pest
			F & F										

	New Jersey							N		
	Allentown[1] SMSA	Jersey City SMSA	Newark SMSA	Paterson SMSA	Philadelphia[2] SMSA	Wilmington[3] SMSA	Non-SMSA Area	Albany SMSA	Buffalo SMSA	New Yor SMSA
Mooney Chemicals, Inc.										
Morton-Norwich Products, Inc.				D & P						
Motomco, Incorporated			Pest							
Nease Chemical Company, Inc.										
Neville Chemical Company										
N L Industries, Inc.		F & F Pl								
Norda Inc.			F & F F & F							
Olin Corporation										
Orbis Products Corporation			F & F							
Passaic Color & Chemical Co.				D & P						
S. B. Penick & Company			F & F Pest	Pl Pest						
Pfizer Inc.										Pl
Phelps Dodge Corporation										Pest
Polak's Frutal Works										
Polychemical Laboratories, Inc.										F & P
Prentiss Drug & Chemical Co., Inc.			Pest							
Publicker Industries Inc.										
PVO International, Inc.			Pl F & F							
Reichhold Chemicals, Inc.			Pl				Pl			
Rhodia Inc.							F & F			
The Richardson Company				RP						
Richardson-Merrell, Inc.	F & F Pl Pest									
Robinson-Wagner Company, Inc.										Pl

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

MID-ATLANTIC STATES (Continued)

	New York						Pennsylvania						
	Albany SMSA	Buffalo SMSA	New York SMSA	Rochester SMSA	Syracuse SMSA	Non-SMSA Area	Allentown[1] SMSA	Johnstown SMSA	Philadelphia[2] SMSA	Pittsburgh SMSA	Reading SMSA	York SMSA	Non-SMSA Area
													Pest
													Pest
										PI RP F & F			
			Pest										
			PI Pest			F & F							
			F & F										
									AcAc(80) Acet(35) Acerh(70) EtOH(40) F & F				
			PI										

REGIONAL PLANT LOCATIO

MID ATLAN

	New Jersey									
	Allentown[1] SMSA	Jersey City SMSA	Newark SMSA	Paterson SMSA	Philadelphia[2] SMSA	Wilmington[3] SMSA	Non-SMSA Area	Albany SMSA	Buffalo SMSA	New S
Rohm and Haas Company										
Royce Chemical Company				Pest						
R.S.A. Corporation										P
Sandoz-Wander, Inc.				Pest Pest						
Scher Brothers, Inc.				Pl F & F						
Shenango Incorporated										
Sobin Chemicals, Inc.			Pl F & F Pest							
Southern California Chemical Co., Inc.							Pest			
Standard Chlorine Chemical Co., Inc.	Pest Nap									
Stauffer Chemical Company							F & F			P
Stepan Chemical Company				F & F						
Sterling Drug Inc.			D & P					Pest		
Sun Chemical Corporation										D
Sybron Corporation				F & F Pl Pest	RP					
Tenneco Chemicals, Inc.			RP Pest D & P	Pest F & F			Pest F & F			
Toms River Chemical Corporation							D & P			
Troy Chemical Corporation			Pest							
Paul Uhlich & Company										D
Ungerer & Company, Inc.				F & F						
Union Carbide Corporation							F & F Acet(50) Ph(150) Pest			

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

MID ATLANTIC STATES (Continued)

New York						Pennsylvania						
Albany SMSA	Buffalo SMSA	New York SMSA	Rochester SMSA	Syracuse SMSA	Non-SMSA Area	Allentown[1] SMSA	Johnstown SMSA	Philadelphia[2] SMSA	Pittsburgh SMSA	Reading SMSA	York SMSA	Non-SMSA Area
								PI MMC (60) Pest Pest				
		F & F										
									CP			
		Pest										
Pest												
		D & P										
										D & P		
		D & P										

REGIONAL PLANT LOCATI

MID ATLA

	New Jersey									
	Allentown[1] SMSA	Jersey City SMSA	Newark SMSA	Paterson SMSA	Philadelphia[2] SMSA	Wilmington[3] SMSA	Non-SMSA Area	Albany SMSA	Buffalo SMSA	Ne
United States Steel Corporation										
Universal Oil Products Company				F & F						
Ventron Corporation				RP Pest						
Vineland Chemical Company							Pest			
West Chemical Products Inc.										
Wheeling-Pittsburgh Steel Corp.										
White Chemical Corporation		Pl Pest								
Whittaker Corporation		Pest								
Wilson Pharmaceutical & Chemical Corp.										
Witco Chemical Corporation										

P

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

MID ATLANTIC STATES (Continued)

	New York						Pennsylvania						
	Albany SMSA	Buffalo SMSA	New York SMSA	Rochester SMSA	Syracuse SMSA	Non-SMSA Area	Allentown[1] SMSA	Johnstown SMSA	Philadelphia[2] SMSA	Pittsburgh SMSA	Reading SMSA	York SMSA	Non-SMSA Area
									CP	PI CP CRE			
										Nap Cresyl(20) Ph CP CRE Naphtha			
										Pest			
										CP			
			PI						PI				

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

SOUTH ATLANTIC STATES – Part A

	Delaware	Maryland		Virginia		
	Wilmington[1] SMSA	Baltimore SMSA	Non-SMSA Area	Norfolk SMSA	Non-SMSA Area	Charleston SMSA
Alco Standard Corporation		Pest				
Allied Chemical Corporation		Pest			Adip(20) Cap(330) Pest	
American Cyanamid Company						
Antox, Incorporated						
Bethlehem Steel Corporation		CP Naphtha Pest				
Borg-Warner Corporation						
Celanese Corporation			AcAn		AcAn	
Chemical Formulators, Inc.						Pest
Chemetron Corporation						
E. I. du Pont de Nemours & Company, Inc.						MMC F & F Pest
Fike Chemicals, Inc.						Pest RP
FMC Corporation		Pest				Pl
Getty Oil Company	OXO(40)					
Hercules Incorporated					EC(25)	
I C I America Inc.	EG(10)					
Koppers Company, Inc.						
Mobay Chemical Company						
Monsanto Company						Pest RP
National Steel Corporation						
Sharon Steel Corporation						
Standard Chlorine Chemical Co., Inc.	Pest Nap					

1) See New Jersey for New Jersey share of Wilmington SMSA
2) See Kentucky and Ohio for their shares of the Huntington-Ashland SMSA

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

SOUTH ATLANTIC STATES – Part A

Maryland		Virginia		West Virginia				
ltimore SMSA	Non-SMSA Area	Norfolk SMSA	Non-SMSA Area	Charleston SMSA	Huntington[2] SMSA	Steubenville SMSA	Wheeling SMSA	Non-SMSA Area
Pest								
Pest			Adip(20) Cap(330) Pest				RP	
								Anil(40) D & P
						RP		
CP Naphtha Pest								RP
	AcAn		AcAn					
				Pest				
					D & P			
				MMC F & F Pest				
				Pest RP				
Pest				Pl				
			EC(25)					
						Nap Cresyl(60) Ph		
								RP Isc(200) Anil(100)
				Pest RP				
						CP		
								CP

ngton SMSA
e Huntington-Ashland SMSA

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

SOUTH ATLANTIC STATES – Part A (Continued)

	Delaware	Maryland		Virginia			
	Wilmington[1] SMSA	Baltimore SMSA	Non-SMSA Area	Norfolk SMSA	Non-SMSA Area	Charleston SMSA	Hunt
Stauffer Chemical Company							
Sun Olin Chemical Company	EO(100)						
Tenneco Chemicals, Inc.			Pl				
Union Carbide Corporation						Aceth(400) Isc(55) PG(80) Acet(150) OXO Pl RP F & F Pest	
Virginia Chemicals Inc.				Pest			
Wheeling-Pittsburgh Steel Corporation							
Witco Chemical Corporation	Pest						
The J. S. Young Company		D & P					

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

SOUTH ATLANTIC STATES – Part A (Continued)

Maryland		Virginia		West Virginia				
more A	Non-SMSA Area	Norfolk SMSA	Non-SMSA Area	Charleston SMSA	Huntington[2] SMSA	Steubenville SMSA	Wheeling SMSA	Non-SMSA Area
								Pl
	Pl							
				Aceth(400) Isc(55) PG(80) Acet(150) OXO Pl RP F & F Pest				
		Pest						
						CP		
& P								

	Florida					Georgia		
	Jacksonville SMSA	Miami SMSA	Orlando SMSA	Pensacola SMSA	Non-SMSA Area	Augusta SMSA	Macon SMSA	Non-SMSA Area
Air Products and Chemicals, Inc.				MeOH(50)				
American Hoechst Corporation								
Arizona Chemical Company					F & F			
Borden Inc.								
Carochem Corporation								F & F
Celanese Corporation								AcAn
Chemical Products Corporation								Pest
Chemol, Incorporated								
Chevron Chemical Company			Pest					
Cindet Chemicals, Inc.								
Comutrix Corporation			Pest					
Cyclo Chemicals Corporation		Pl						
Diamond Shamrock Chemical Company								Pl
E. I. du Pont de Nemours & Company, Inc.								
Florida Chemical Company, Inc.					F & F			
Henkel Inc.								
Hercules Incorporated								F & F Pest
Kewanee Oil Company								
Mallinckrodt Chemical Works								
Martin Marietta Corporation								
McLaughlin Gormley King Company								
Mobil Oil Corporation								
Monsanto Company				Adip(540)				
National Starch and Chemical Corporation								
Nipro, Inc.						Cap(160)		
PCR, Incorporated					Pest			
Pfizer Inc.								

ON FOR MAJOR ORGANIC CHEMICALS

ANTIC STATES – Part B

Georgia		North Carolina						South Carolina	
Macon SMSA	Non-SMSA Area	Charlotte SMSA	Fayetteville SMSA	Greensboro SMSA	Raleigh SMSA	Wilmington SMSA	Non-SMSA Area	Charleston SMSA	Non-SMSA Area
									DMT(140)
			Pest						
	F & F								
	AcAn								Pest
	Pest								AcAn
				Pl					
				Pl					
				F & F					
	Pl	Pl							
				Pest					
		Pl							
	F & F					Pest			
	Pest					DMT(600)			
							D & P		
					Pest				
		RP							
		D & P							
									Pest
									F & F
									Pest
							Pl		
0)									
				Pest					
				Pl					
				F & F					

REGIONAL PLANT LOCATION FOR MAJOR ORGANI

SOUTH ATLANTIC STATES – Part B (Contin

	Florida					Georgia		
	Jacksonville SMSA	Miami SMSA	Orlando SMSA	Pensacola SMSA	Non-SMSA Area	Augusta SMSA	Macon SMSA	Non-SMSA Area
Reichhold Chemicals, Inc.								Pest
SCM Corporation	F & F							
Sonoco Products Company								
Sun Chemical Corporation								
Synalloy Corporation								
Tenneco Chemicals, Inc.				F & F				
Triangle Chemical Company							Pest	
Union Camp Corporation	F & F							
Uniroyal, Inc.								
Woolfolk Chemical Works, Ltd.								Pest
BASF Wyandotte Corporation								

Georgia		North Carolina						South Carolina	
Macon SMSA	Non-SMSA Area	Charlotte SMSA	Fayetteville SMSA	Greensboro SMSA	Raleigh SMSA	Wilmington SMSA	Non-SMSA Area	Charleston SMSA	Non-SMSA Area
	Pest	Pest							Pest
									AcAc
									Pest
								F & F D & P	
Pest									
							Pest		
	Pest								
		D & P							

REGIONAL PLANT LOCATION FOR MA

EAST NORTH CENTRAL STA

	Illinois				Indiana		
	Chicago SMSA	Peoria SMSA	St. Louis[1] SMSA	Non-SMSA Area	Gary SMSA	Indianapolis SMSA	Terre Ha SMSA
Abbott Laboratories	F & F Pest						
Akzona Incorporated	F & F						
Aldrich Chemical Company, Inc.							
Allied Chemical Corporation							
American Bio-Synthetics Corporation							
The Ansul Company							
Ashland Chemical Company		Pl					
Borden Inc.							
Chemetron Corporation							
Citizens Gas & Coke Utility						CP	
Clark Oil & Refining Corporation	F & F Acet(35) Ph(75)						
Commercial Solvents Corporation							F & F Pl EtOH Acet
Cosden Oil & Chemical Company	Pest						
Crucible Steel Co. of America							
Diamond Shamrock Corporation							
Dow Chemical U.S.A.							
E. I. du Pont de Nemours & Company, Inc.					Pest		
Farmers Chemical Company							
Florasynth Inc.	F & F						
Ford Motor Company							
General Electric Company							

1) See Missouri for Missouri share of St. Louis SMSA

OCATION FOR MAJOR ORGANIC CHEMICALS

RTH CENTRAL STATES – Part A

Indiana			Michigan					Wisconsin	
polis	Terre Haute SMSA	Non-SMSA Area	Detroit SMSA	Grand Rapids SMSA	Kalamazoo SMSA	Muskegon SMSA	Non-SMSA Area	Milwaukee SMSA	Non-SMSA Area
								Pest F & F	
			Nap(200) CP						
								F & F	
									F & F Pest
									Pest
				D & P					
	F & F Pl EtOH Acet								
							CP		
								CP	
							Pl F & F RP Ph(100) Pest		
					F & F				
			CP						
		Bis A(60)							

	Illinois				Indiana		
	Chicago SMSA	Peoria SMSA	St. Louis[1] SMSA	Non-SMSA Area	Gary SMSA	Indianapolis SMSA	Terre Haut SMSA
General Motors Corp.	CP						
Glenn Chemical Company, Inc.	Pest						
The B. F. Goodrich Company				RP			
Granite City Steel Corp.			CP				
Great Lakes Carbon Corporation							
Guardsman Chemical Coatings, Inc.							
The C. P. Hall Company	Pl F & F						
Indiana Gas & Chemical Corporation							CP
Industrial Color Inc.	D & P						
Inland Steel Company					CP		
Interlake, Inc.	Nap CP						
International Harvester Company	CP						
Kingsford Chemical Company							
Koppers Company, Inc.	Nap						
Lachat Chemicals Inc.	F & F RP						
Lawter Chemicals, Inc.	Pest						
Eli Lilly and Company						Pest	
Lonza Inc.		Pest					
Lowe's, Inc.				Pest			
Michigan Chemical Corporation							
Miles Laboratories, Incorporated							
Monsanto Company			Pest Pl RP				
Morton-Norwich Products, Inc.	F & F						
National Distillers and Chemical Corporation				EtOH(450)			

LOCATION FOR MAJOR ORGANIC CHEMICALS

TH CENTRAL STATES – Part A (Continued)

Indiana			Michigan					Wisconsin	
polis SA	Terre Haute SMSA	Non-SMSA Area	Detroit SMSA	Grand Rapids SMSA	Kalamazoo SMSA	Muskegon SMSA	Non-SMSA Area	Milwaukee SMSA	Non-SMSA Area
			CP						
			Pl						
	CP								
							AcAc		
		Pest							
							Pest		
				RP					

	Illinois				Indiana		
	Chicago SMSA	Peoria SMSA	St. Louis[1] SMSA	Non-SMSA Area	Gary SMSA	Indianapolis SMSA	Terre Haut SMSA
National Steel Corporation			Nap(<2)				
Nor-Am Agricultural Products, Inc.	Pest						
Northern Natural Gas Company	EO(240) EG(300)						
Olin Corporation	Pest						
Pennwalt Corporation							
PPG Industries, Inc.							
Reilly Tar & Chemical Corporation			Nap				
Republic Steel Corporation	Nap CP Naphtha						
Riverdale Chemical Company	Pest						
The Sherwin-Williams Co.	P1 P-CRL						
Southern California Chemical Co., Inc.	Pest						
Standard Oil Company (Indiana)	DMT(100)						
Stange Co.	D & P						
Sterling Drug Inc.							
Story Chemical Corporation							
Su Crest Corporation	P1						
Union Carbide Corporation					Isp(330) Acet(110)		
United States Steel Corporation					Nap CP Naphtha		
Universal Oil Products Company	RP						
Velsicol Chemical Corporation				Pest			
Warner-Lambert Company							
Witco Chemical Corporation	Pest P1						
Wm. Wrigley Jr. Company	F & F						
BASF Wyandotte Corporation							
Youngstown Sheet & Tube Co.					CP		

OCATION FOR MAJOR ORGANIC CHEMICALS

CENTRAL STATES – Part A (Continued)

Indiana			Michigan					Wisconsin	
polis SMSA	Terre Haute SMSA	Non-SMSA Area	Detroit SMSA	Grand Rapids SMSA	Kalamazoo SMSA	Muskegon SMSA	Non-SMSA Area	Milwaukee SMSA	Non-SMSA Area
			Nap						
			RP Pest						Pest
									F & F
					Isc(neg)				
			F & F						
			PO(160)						

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

EAST NORTH CENTRAL STATES – Part B

	Akron SMSA	Canton SMSA	Cincinnati SMSA	Cleveland SMSA	Hamilton SMSA	Ohio Huntington[1] SMSA
Allied Chemical Corporation						CP Pl
American Cyanamid Company						
Armco Steel Corporation					CP Nap CP	
Chevron Chemical Company				Pest		
Cincinnati Milacron, Inc.			D & P Pest			
Cities Service Company, Incorporated			D & P			
Detroit Steel Corp.						
Diamond Shamrock Corporation				CP		
Dover Chemical Corporation						
F. I. du Pont de Nemours & Company, Inc.				RP		
Emery Industries, Inc.			Pl			
Ferro Corporation				Pest		
The General Tire & Rubber Company	RP					
The Goodyear Tire & Rubber Company	RP					
The B. F. Goodrich Company	RP					
Interlake, Inc.						
Kewanee Oil Company				Nap Anth Pest		
Monsanto Company			Pest			
Nease Chemical Company, Inc.						
Pan American Chemical Corporation						
PPG Industries, Inc.	Pest					
The Procter & Gamble Company			F & F			
Reilly Tar & Chemical Corporation				Nap		
Republic Steel Corporation		CP		Nap CP		

1) See Kentucky and West Virginia for their share of Huntington-Ashland SMSA

NAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

EAST NORTH CENTRAL STATES – Part B

Ohio								
Cincinnati SMSA	Cleveland SMSA	Hamilton SMSA	Huntington[1] SMSA	Lima SMSA	Lorain SMSA	Toledo SMSA	Youngstown SMSA	Non-SMSA Area
			CP Pl					
								D & P RP
		CP Nap CP						
	Pest							
D & P Pest								
D & P								
								CP CRE
	CP							
								Pest
	RP					Pest		
Pl								
	Pest							
								Isc(40)
					Pl			
						Nap CP		
	Nap Anth Pest				Nap Anth Pest			
Pest								
								Pest
						Pent(25)		
F & F								
	Nap							
	Nap CP						Nap CP	
							Nap CP Naphtha	

[1] Huntington-Ashland SMSA

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

EAST NORTH CENTRAL STATES – Part B (Continued)

	Ohio						
	Akron SMSA	Canton SMSA	Cincinnati SMSA	Cleveland SMSA	Hamilton SMSA	Huntington[1] SMSA	L... S...
The Shepherd Chemical Company			Pest				
The Sherwin-Williams Co.			F & F				
The Standard Oil Company (Ohio)							Ac... Pe...
Stauffer Chemical Company				Pest			
Sterling Drug Inc.			D & P				
Sun Chemical Corporation			D & P				
Union Camp Corporation							
Union Carbide Corporation							
Uniroyal, Inc.				VCM			
United States Steel Corporation							
Youngstown Sheet & Tube Co.							

NAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

EAST NORTH CENTRAL STATES – Part B (Continued)

Ohio								
Cincinnati SMSA	Cleveland SMSA	Hamilton SMSA	Huntington[1] SMSA	Lima SMSA	Lorain SMSA	Toledo SMSA	Youngstown SMSA	Non-SMSA Area
Pest								
F & F								
				Acryl(350)				
				Pest				
	Pest							
D & P								
D & P								
								Pl
								F & F
								Bis A(40)
	VCM							
								Acet(130)
								Ph(215)
								OXO(70)
							CP	

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

WEST NORTH CENTRAL STATES

	Iowa	Kansas			Minnesota	
	Non-SMSA Area	Kansas City[1] SMSA	Wichita SMSA	Non-SMSA Area	Duluth Superior SMSA	Minneapolis St. Paul SMSA
Amchem Products, Inc.	Pest					
Chemagro Corporation						
Chevron Chemical Company	Pest					
Gordon Corporation		Pest				
Grain Processing Corp.	EtOH					
Gulf Oil Corporation				Pest		
Hercules Incorporated						
Imperial, Inc.	Pest					
Koppers Company, Inc.						CP
Mallinckrodt Chemical Works						
Monsanto Company	Pest					
McLaughlin Gormley King Co.						Pest
North Eastern Pharmaceutical & Chemical Company						
The Procter & Gamble Company		F & F				
Reichhold Chemicals, Inc.		Pest				
Rhodia Inc.						Pest
Skelly Oil Company			F & F Acet(30) Ph(50)			
Thompson Chemicals Corp.						
Thompson-Hayward Chemical Co.		Pest				
United States Steel Corporation					CP	
Vulcan Materials Company			Pest			
Warner-Jenkinson Company						

1) See Missouri for Missouri share of Kansas City SMSA
2) See Kansas for Kansas share of Kansas City SMSA
3) See Illinois for Illinois share of St. Louis SMSA

Capacities listed in parenthesis when available in millions of pounds per year.

NAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

WEST NORTH CENTRAL STATES

		Minnesota		Missouri			
hita SMSA	Non-SMSA Area	Duluth Superior SMSA	Minneapolis St. Paul SMSA	Kansas City[2] SMSA	St. Joseph SMSA	St. Louis[3] SMSA	Non-SMSA Area
					Pest		
				Pest			
						Pest	
	Pest						
							Pest Pent(40) Pl
			CP				
						Pest	
						Pl F & F	
			Pest				
							Pest
			Pest	Pest	Pest		
& F t(30) (50)							
						Pest	
		CP					
t							
		-				D & P	

of pounds per year.

	Alabama					Kentucky	
	Birmingham SMSA	Gadsden SMSA	Mobile SMSA	Tuscaloosa SMSA	Non-SMSA Area	Huntington[1] SMSA	Louisville SMSA
Alabama By-products Corporation	CP Naphtha						
Alco Standard Corporation							
Allied Chemical Corporation						CP	
American Can Company							
Borden Inc.					Pest		Pest
Buckman Laboratories, Inc.							
Chemetron Corporation							
Ciba-Geigy Corporation					Pest D & P		
Commercial Chemical Company							
Continental Oil Company							
E. I. du Pont de Nemours & Company, Inc.							Aceth(10
Eastman Kodak Company							
Empire Coke Company				CP			
First Mississippi Corporation							
Forest Products Chemical Company							
GAF Corporation							
The B. F. Goodrich Company							
Gulf Oil Corporation							
Hercules Incorporated							
Kerr-McGee Corporation							
Kewanee Oil Company							D & P

1) See West Virginia and Ohio for their share of Huntington-Ashland SMSA

PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

EAST SOUTH CENTRAL STATES

Kentucky			Mississippi	Tennessee				
Huntington[1] SMSA	Louisville SMSA	Non-SMSA Area	Non-SMSA Area	Chattanooga SMSA	Knoxville SMSA	Memphis SMSA	Nashville SMSA	Non-SMSA Area
				RP				
CP								
		Pest						
	Pest							
						RP		
								RP
						Pest		
			Pl					
	Aceth(10)					Pest DMT(230) MMC(120) Acryl(180)		
								AcAc DMT(325) AcAn(600) Acet(80) MEK Pl F & F RP Pest D & P
			Pest Anil(70)					
						AcAc		
		D & P Pest						
		Pest VCM(1000) EDC(900)						
			Pest					
			Pest					
			Pest					
	D & P							

	Alabama					Kentucky	
	Birmingham SMSA	Gadsden SMSA	Mobile SMSA	Tuscaloosa SMSA	Non-SMSA Area	Huntington[1] SMSA	Louisvil SMSA
The Mead Corporation	Nap (<2)						
Mobil Oil Corporation							
Monsanto Company					Pest		
Olin Corporation					Pest		
Reichhold Chemicals, Inc.				Pest Pent(12) Ph(135)			
Republic Steel Corporation	Nap CP Naphtha	Nap CP Naphtha					
Rohm and Haas Company							MMC
Shell Chemical Company			Pest				
Standard Oil Company (Indiana)					DMT(180)		
Stauffer Chemical Company			Pest				Pest
Thiokol Chemical Corporation							
Tull Chemical Company, Inc.					Pest		
United States Pipe & Foundry Company	CP						
United States Steel Corporation	Nap CP CRE						
R. T. Vanderbilt Company, Inc.							
Velsicol Chemical Corporation							
Witco Chemical Corporation			Pest				
Woodward Iron Company	CP Naphtha						

AL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

EAST SOUTH CENTRAL STATES (Continued)

	Kentucky			Mississippi	Tennessee				
SA	Huntington[1] SMSA	Louisville SMSA	Non-SMSA Area	Non-SMSA Area	Chattanooga SMSA	Knoxville SMSA	Memphis SMSA	Nashville SMSA	Non-SMSA Area
									Pest
			EO(110) EG(50) PO(130) PG(45) Pest						
		MMC				Pl MMC			
180)		Pest		Pl					Pest
			RP		Pest F & F Pl		Pest		
					CP Naphtha				

	Arkansas	Louisiana					Be
	Non-SMSA Area	Baton Rouge SMSA	Lake Charles SMSA	Monroe SMSA	New Orleans SMSA	Non-SMSA Area	S
Allied Chemical Corporation		Pest F & F VCM(300) EDC(650)					
American Cyanamid Company					MMC(80) Acryl(175) Pest		
The Ansul Company	Pest						
Armco Steel Corporation							
Atlantic Richfield Company							
Borden Inc.						VA(150) MeOH(160) AcAc(115)	
Bromet Company	Pest						
Calcasieu Chemical Corporation			EO(165) EG(180)				
Celanese Corporation							
Ciba-Geigy Corporation						Pest	
Commercial Solvents Corporation				Pest MeOH(50)			
Continental Oil Company			Pest F & F VCM(600) EDC(1000)				
Crowley Tar Products Company, Inc.							
Diamond Shamrock Chemical Company							
Dixie Chemical Company							

ATION FOR MAJOR ORGANIC CHEMICALS

SOUTH CENTRAL STATES

Non-SMSA Area	Texas: Beaumont SMSA	Brownsville SMSA	Corpus Christi SMSA	Dallas SMSA	El Paso SMSA	Galveston SMSA	Houston SMSA	Odessa SMSA	Non-SMSA Area
							CP Isp(50) MEK(50)		
VA(150) MeOH(160) AcAc(115)									Pest
			F & F MeOH(90) Pent(50) Aceth(240) AcAc(100) EG(5) PO(10) PG(10) Acet(35) Pest				VAM(350) MeOH(200) Aceth(500) AcAc(300) EO(300) EG(300)		F & F VAM(300) Adip(125) Aceth(250)
									EtAcr VAM Aceth(10) AcAc(550) AcAn MEK(115)
Pest									
							CRL Cresyl		
							Pest EDC(260) Pest		
							EG Acet(24) MEK		

REGIONAL PLANT LOCATION FOR MAJOR C

WEST SOUTH CENTRAL STATES (C

	Arkansas	Louisiana					Be
	Non-SMSA Area	Baton Rouge SMSA	Lake Charles SMSA	Monroe SMSA	New Orleans SMSA	Non-SMSA Area	
Dow Badische Company							
Dow Chemical U.S.A.	Pest					VCM(390) EDC(1160) EO(400) EG(470) PO(200) PG(100) Pest	
E. I. du Pont de Nemours & Company, Inc.						Pest	
Eastman Kodak Company							
El Paso Natural Gas Company							
Ethyl Corporation		Pest VCM(325) EDC(550) TEL					
Exxon Corporation		Pl EtOH(400) Isp(680) OXO(200)					
FMC Corporation							
GAF Corporation							

ION FOR MAJOR ORGANIC CHEMICALS

ENTRAL STATES (Continued)

Non-SMSA Area	Texas								
	Beaumont SMSA	Brownsville SMSA	Corpus Christi SMSA	Dallas SMSA	El Paso SMSA	Galveston SMSA	Houston SMSA	Odessa SMSA	Non-SMSA Area
							F & F EtAcr Cap(250) OXO(200)		
VCM(390) EDC(1160) EO(400) EG(470) PO(200) PG(100) Pest							Bis A(100) PO(700) VCM(200) EDC(1100) EO(200) EG(240) PG(150) Pest		
							VCM(700) EDC(1000) Acet(240) Ph(400) Pest		
Pest	Pest Acryl(200) MeOH(200) Anil(200)						Pest VAM(300) RP		Adip(300) Pest
	Adip(300) MeOH(115)								
									Aceth(500) EtOH(165) EO(60) EG(75) Isp OXO(275) F & F Pl
								Adip(80) F & F Pl	
							VCM(150) EDC(260) Pest TEL		
							Pest AcAc(40)		
						Pest			

REGIONAL PLANT LOCATION FOR MAJOR C

WEST SOUTH CENTRAL STATES (C

	Arkansas	Louisiana					
	Non-SMSA Area	Baton Rouge SMSA	Lake Charles SMSA	Monroe SMSA	New Orleans SMSA	Non-SMSA Area	Be
Georgia-Pacific Corporation						MeOH(100) Acet(120) Ph(200)	
The Goodyear Tire & Rubber Company							
Great Lakes Chemical Corp.	Pest						
Hercules Incorporated						MeOH(30) Pest	
Jefferson Chemical Company, Inc.							Pe EDC EO(EG(PO(PG(
Kennecott Copper Corporation							
Koch Industries, Inc.							EO(EG(
Lone Star Steel Company							
The Merichem Company							
Michigan Chemical Corp.	Pest						
Mobay Chemical Company							
Mobil Oil Corporation							AcA
Monochem, Inc.						VCM(300)	
Monsanto Company						Adip(60) Pest	
National Distillers and Chemical Corporation							
National Starch and Chemical Corporation							
Olin Corporation			RP				
Pennwalt Corporation							
Phelps Dodge Corporation							
Phillips Petroleum Company							

ATION FOR MAJOR ORGANIC CHEMICALS

CENTRAL STATES (Continued)

Texas								
Non-SMSA Area	Beaumont SMSA	Brownsville SMSA	Corpus Christi SMSA	Dallas SMSA	El Paso SMSA	Galveston SMSA	Houston SMSA	Odessa SMSA	Non-SMSA Area
MeOH(100) Acet(120) Ph(200)									
							RP		
MeOH(30) Pest									
	Pest EDC(70) EO(500) EG(360) PO(160) PG(50)								
							Pest		
	EO(50) EG(40)								
									CP Naphtha
							Ph		
							Isc(150)		
	AcAc(30)								
VCM(300)									
Adip(50) Pest						AcAc(300) MeOH(100) Aceth(5) OXO(150) Pl	Acryl(370) Acet(240) Ph(375) Pest		
							VAM(300)		
									VAM(60)
							Pest PO(500) PG(180) Acet(60)		
							RP		Pest
					Pest				
					F & F RP				

	Arkansas	Louisiana					
	Non-SMSA Area	Baton Rouge SMSA	Lake Charles SMSA	Monroe SMSA	New Orleans SMSA	Non-SMSA Area	Beau SM
PPG Industries, Inc.			VCM(400) EDC(1000) Pest				EO(EG(TEL Pes
Publicker Industries Inc.					EtOH		
Reichhold Chemicals, Inc.					EtOH		
Rohm and Haas Company							
Rubicon Chemicals Inc.						Isc(110) Anil(52) Pest RP	
Shell Chemical Company						Aceth(5) Acet(100) MEK(50) Pest	
						EO(300) EG(100) OXO(150)	
The Signal Companies, Inc.							
Sonford Chemical Company							Pest
Southern California Chemical Co., Inc.							
Tenneco Chemicals, Inc.							
Thompson-Hayward Chemical Company					Pest		
Union Carbide Corporation						EtAcr EDC(150) EO(450) EG(530) AcAc(90) Pest Pl	
Uniroyal, Inc.						RP Pest	
The Upjohn Company							

Non-SMSA Area	Texas								
	Beaumont SMSA	Brownsville SMSA	Corpus Christi SMSA	Dallas SMSA	El Paso SMSA	Galveston SMSA	Houston SMSA	Odessa SMSA	Non-SMSA Area
	EO(85) EG(100) TEL(100) Pest								
							Pest		
							Pest EthAcr MMC(400) MeOH(22)		
Isc(110) Anil(52) Pest RP									
Aceth(5) Acet(100) MEK(50) Pest							VCM(840) EDC(1200) EtOH(265) Isp(610) Acet(430) MEK(100) Ph(60) Bis A(150) OXO(200) Pest F & F		
EO(300) EG(100) OXO(150)									
							Acet		
	Pest								
				Pest					
							VCM(225) MeOH(80)		
EtAcr EDC(150) EO(450) EG(530) AcAc(90) Pest Pl		AcAn MEK(75) AcAc(540)				VAM(245) EDC(150) EtOH(660) Isp(570) Acet(110) OXO(200) Pest F & F			EO(730) EG(530) OXO(200) F & F
RP Pest									
							Isc(200)		

	Arkansas	Louisiana					
	Non-SMSA Area	Baton Rouge SMSA	Lake Charles SMSA	Monroe SMSA	New Orleans SMSA	Non-SMSA Area	Beaum SMSA
Velsicol Chemical Corporation							
Vulcan Materials Company						EDC(240) Pest	
Witco Chemical Corporation						Pest	
BASF Wyandotte Corporation						EO(175) EG(150) Isc(40)	
Wright Chemical Corporation	Pest						

ATION FOR MAJOR ORGANIC CHEMICALS

CENTRAL STATES (Continued)

	Texas								
Non-SMSA Area	Beaumont SMSA	Brownsville SMSA	Corpus Christi SMSA	Dallas SMSA	El Paso SMSA	Galveston SMSA	Houston SMSA	Odessa SMSA	Non-SMSA Area
							Pest		
EDC(240) Pest									
Pest									
EO(175) EG(150) Isc(40)									

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

MOUNTAIN STATES

	Colorado			Idaho	Nevada	Mont
	Denver SMSA	Pueblo SMSA	Non-SMSA Area	Other SMSA	Las Vegas SMSA	Great Falls SMSA
Alpha Laboratories Inc.	Pest					
American Smelting and Refining Co.	Pest					
The Anaconda Company						Pest
Borden Inc.						
CF&I Steel Corporation		Nap(L2)				
Great Western Sugar Company			F & F			
Shell Chemical Company	Pest					
Stauffer Chemical Company					Pest RP	
Syntex Corporation	Pest F & F					
United States Steel Corporation						
VWR United Corporation				Pest		

Capacities listed in parenthesis when available in millions of pounds per year.

ANT LOCATION FOR MAJOR ORGANIC CHEMICALS

MOUNTAIN STATES

	Idaho	Nevada	Montana		Utah	
SMSA ea	Other SMSA	Las Vegas SMSA	Great Falls SMSA	Non-SMSA Area	Provo-Orem SMSA	Salt Lake City SMSA
			Pest			
				Pest		
F						
	Pest RP					
					CP	
	Pest					Pest

of pounds per year.

	California					
	Anaheim SMSA	Los Angeles SMSA	Sacramento SMSA	San Bernardino SMSA	San Francisco SMSA	San Jose SMSA
Amchem Products, Inc.					Pest	
American Chemical Corporation		VCM(175) EDC(325) Pest				
Borden Inc.					Pest	
Chempar Chemical Co., Inc.						
Chevron Chemical Company					Acet(30) Ph(55) Pest	
Diamond Shamrock Chemical Company					Pl F & F	
Dow Chemical U.S.A.					Pest	
E. I. du Pont de Nemours & Company, Inc.					TEL(340)	
Georgia-Pacific Corporation						
E. F. Houghton & Company					Pl	
Imperial West Chemical Company					Pest	
Kaiser Steel Corporation				Ph CP		
Kalama Chemical Inc.						
Kerr-McGee Chemical Corp.		Pest				
Liquid Chemical Corp.						
Los Angeles Chemical Company		Pest				
Mobil Oil Corporation		Pest				
Monsanto Company						
Montrose Chemical Corporation of California		Pest				
Neville Chemical Company	Pl					
Niklor Chemical Company, Inc.		Pest				
Pennwalt Corporation						
The Procter & Gamble Company			F & F			
Productol Chemical Company		Ph RP				
Reichhold Chemicals, Inc.						
Rhodia Inc.						

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

PACIFIC STATES

fornia				Oregon			Washington		
nardino MSA	San Francisco SMSA	San Jose SMSA	Non-SMSA Area	Eugene SMSA	Portland SMSA	Non-SMSA Area	Seattle SMSA	Tacoma SMSA	Non-SMSA Area
	Pest								
	Pest			Pest		Pest	Pest		
					Pest				
	Acet(30) Ph(55) Pest								
	Pl F & F								
	Pest								
	TEL(340)								
									Eth
	Pl								
	Pest								
									F & F Ph(55)
			Pest						
				Pest			F & F		
					Pest				
						Pest		Pest	
						Pest			
					Pest				

	California					
	Anaheim SMSA	Los Angeles SMSA	Sacramento SMSA	San Bernardino SMSA	San Francisco SMSA	San Jo SMSA
F. Ritter & Company		F & F				
Shell Chemical Company		Isp(250) Acet(100) MEK			F & F	
Skelly Oil Company						
Southern California Chemical Co., Inc.		Pest				
Specialty Organics, Inc.		Pest				
Stauffer Chemical Company					Pest	
Stimson Lumber Company						
Sunkist Growers, Inc.				F & F		
Tenneco Chemicals, Inc.		RP Pest			D & P	
Thompson-Hayward Chemical Company	Pest					
William Underwood Company						F &
VWR United Corporation						
Witco Chemical Corporation		Pest				

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

PACIFIC STATES (Continued)

California				Oregon			Washington		
rnardino SMSA	San Francisco SMSA	San Jose SMSA	Non-SMSA Area	Eugene SMSA	Portland SMSA	Non-SMSA Area	Seattle SMSA	Tacoma SMSA	Non-SMSA Area
	F & F								
					Pest				
	Pest								Ph
F & F									
	D & P								
		F & F							
					Pest				Pest

REGIONAL PLANT LOCATION FOR MAJOR ORGANIC CHEMICALS

Puerto Rico

Fibers International Corporation	Adip (65)
Oxochem Enterprise	F & F OXO (245)
PPG Industries, Inc.	Pest VCM (500) EDC (835) EO (400) EG (400)
Reichhold Chemicals, Inc.	VAM
Union Carbide Corporation	EO (610) EG (610) Acet (120) Ph (200) Bis A (140) OXO (140) EtOH (960)
Vineland Chemical Company	RP Pest